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# AN ANTHOLOGY OF SELECTED READINGS FOR THE NATIONAL CONFERENCE ON MANAGING THE ENVIRONMENT

INTERNATIONAL CITY MANAGEMENT ASSOCIATION

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An Anthology of
Selected Readings for the

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# National Conference on Managing the Environment

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# An Anthology of
# Selected Readings for the
# NATIONAL CONFERENCE ON
# MANAGING THE ENVIRONMENT

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Sponsored by the Environmental Protection Agency
Office of Research and Monitoring
Environmental Studies Division

Prepared by the International City Management Association

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# FORWARD

In the past few years increasing pressures have been brought to bear on public officials at the local, state and federal levels to produce positive results in the battle to preserve and enhance environmental quality. Consequently, elected officials and professional administrators who traditionally had the responsibility for certain environment-related programs, are now expected to become more generally expert in environmental matters and be "environmental managers." Unfortunately, the demands on public officials have outstripped the preparation and resources available to them for managing environmental problems; they are often not equipped to deal effectively to alleviate today's environmental problems and avoid the problems of tomorrow. Long range comprehensive environmental considerations must be part of nearly every decision made by public and private agencies. It is time to focus on the increased demands on environmental managers and augment their working knowledge and tools by developing a theoretical framework, methodology, and specific techniques to meet their new responsibilities. In fact, such activities are well underway. For example, the Office of Research and Monitoring is helping to support an innovative and comprehensive project in San Diego, California, which utilizes sophisticated techniques to develop alternative methods of achieving mandated Air Quality goals. A progress report, outlining results achieved to date, will be delivered at the conference.

In recognition of the growing importance and numbers of local, regional, state and federal environmental managers, the Environmental Protection Agency funded the International City Management Association to conduct a research program aimed at (a) identifying and analyzing the definition of environmental management as perceived by local officials; (b) identifying the tools which cities are using to measure environmental quality at the present time and establish what additional information and methodologies they may require for improved measurement; and (c) improving the process of managing the environment at the local level.

As part of this effort, the National Conference on Managing the Environment was planned for May 14-15, 1973, in Washington, D.C. This anthology, which is a key input to that conference, was prepared under the research grant from the Environmental Studies Division, Office of Research and Monitoring of the Environmental Protection Agency. The anthology was compiled under the direction of Dr. Peter House, Division Director, and Mr. Alan Neuschatz, Chief of the Division's Environmental Management Research Branch.

At the International City Management Association, the development of the anthology and editing of the articles was shared by Mr. Steven Carter, ICMA Project Director; Dr. Lyle Sumek, Professor of Public Administration, Northern Illinois University; and Mary Ann Allard, ICMA Research Associate. Claire Rubin, Director of ICMA's Contracts Research Center, and Joan Werner, Research Assistant, also participated in the editing and writing process. A word of gratitude is also due to ICMA Staff Members David Arnold, Betty Lawton, Harriett Davis, Shirley Bass, Wallace Johnson, Mary Schellinger, Diana Brown, Beth Payne, Cheryl Wright, and Phyllis Hammerschlag for their assistance.

Stanley M. Greenfield

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# INTRODUCTION

Man's conscious or unconscious impact on the environment, and consequently on his own quality of life, can be evidenced in the many recent changes in the biosphere. One of man's impacts on the biosphere is a build-up of toxic substances such as synthetic chemicals, pesticides, petroleum and its products (notably plastics), radiation and heavy metals. For example, until a few years ago there were few metropolitan areas where activities had to be curtailed as a result of air pollution. However, the increase in the number and frequency of use of automobiles has introduced sufficient quantity of carbon monoxide, nitrogen oxides, sulfates and other chemicals into the atmosphere so as to cause serious air pollution problems in most of our metropolitan areas. Another impact of man is his heavy drain on the fixed supply of natural resources. The demand for new housing, for example, as well as other community needs requiring large scale land development have placed a strain on land resources, water resources and timber resources. A third impact of man is that of vast accumulations of wastes. Burgeoning consumption combined with modern packaging techniques and products more difficult to dispose of have increased solid and liquid wastes to a new level where capacity of certain areas for disposal has been exhausted.

The short term consequences of man on the environment can be seen in the numerous environmental crises that have occurred during the last few years, including oil spills, radiation and pollution contamination from nuclear power plants, and massive soil erosion. Today, long term consequences such as the disappearance of various species of wildlife are being documented. Faced with the seriousness of this situation, the question is how does man organize himself, his resources and his activities for the developing and implementing programs for preserving and enhancing the environment? Environmental management attempts to address this question.

While local, state and federal agencies have long been involved in environment-related programs, over the last few years they have been assuming a much broader role in environmental management. They have initiated a wide range of new legislation and programs aimed at a better managed environment. As his first act of the 1970's, President Nixon signed into law the National Environmental Policy Act and remarked:

> "It's particularly fitting that my first act in this decade is to approve the National Environmental Policy Act. . . I have become further convinced that the 1970's absolutely must be the years when America pays its debt to the past by reclaiming the purity of its air, its water, and our living environment. It's literally now or never. . . we are determined that the decade of the '70's will be known as a time when this country regained a productive harmony between man and nature."*

Today's public official finds himself increasingly involved in the complex political, technical and administrative milieu surrounding environmental concerns and pressured to become an "environmental manager." He is constantly affected by a variety of forces which simultaneously stimulate and constrain his actions. These forces (see Figure 1) include:

-- Unique ecological factors, such as a fragile micro-ecosystem (e.g. natural desert, ocean beach or wildlife sanctuary) or special ecological conditions (e.g. location on an earthquake fault or susceptibility to temperature inversion);

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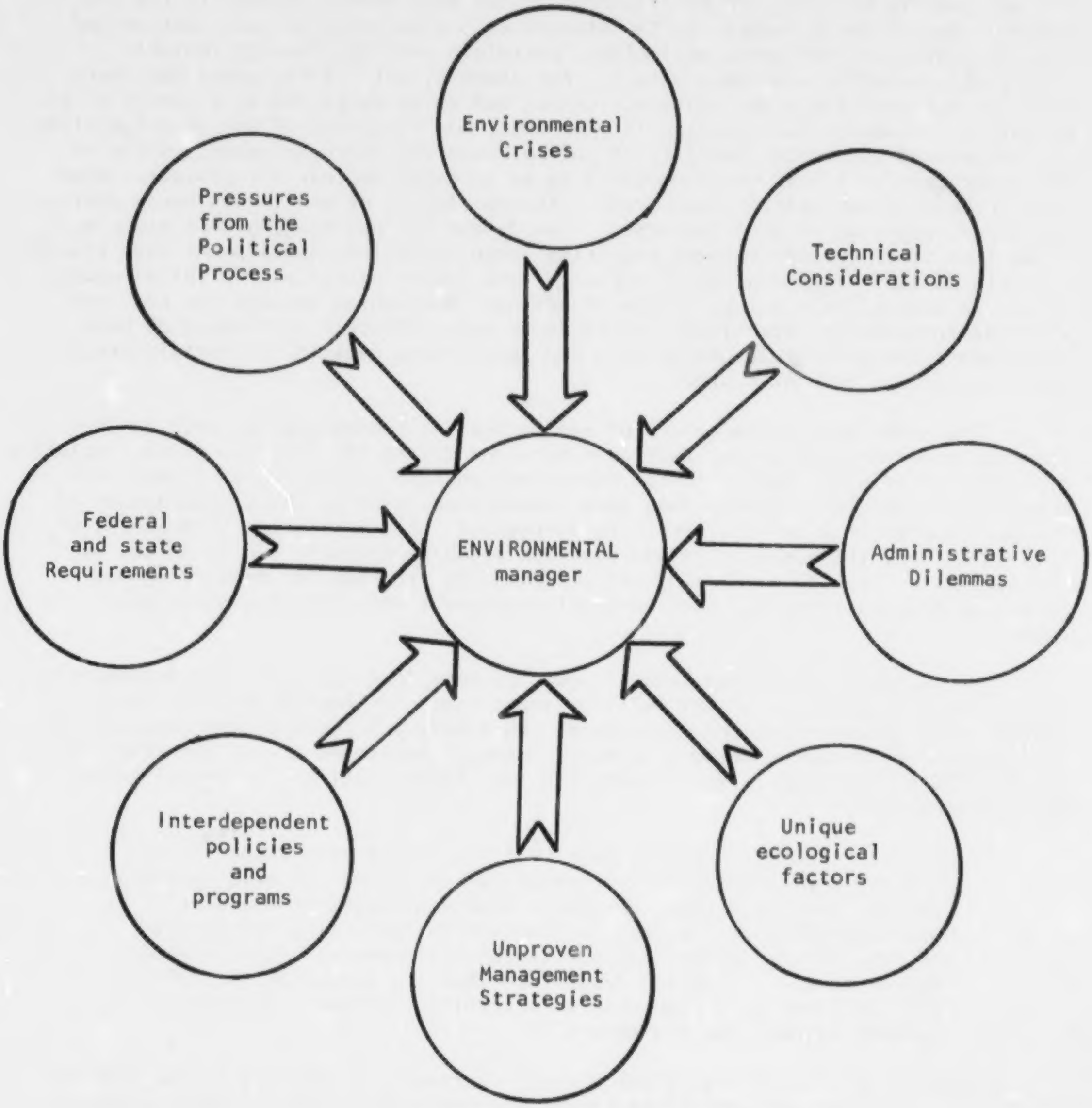
* Statement by the President, Press Release, Office of the White House, San Clemente, California, January 1, 1970.

Figure 1

FORCES ACTING UPON ENVIRONMENTAL MANAGERS


Environmental Crises
Pressures from the Political Process
Technical Considerations
Federal and state Requirements
ENVIRONMENTAL manager
Administrative Dilemmas
Interdependent policies and programs
Unique ecological factors
Unproven Management Strategies

-- Environmental crises such as natural disasters, oil spills, smog alerts, and soil erosion;

-- Pressures from the political process, as evidenced in the types of citizen participation, what groups see as environmental problems, the particular solutions they promote, and the extent of their influence on decision-making;

-- Unproven management strategies, which result from a lack of working knowledge or insufficient analysis of effectiveness of alternative strategies such as environmental impact statements, land use planning, environmental quality standards, financial incentives or penalties, growth controls, etc.;

-- Administrative dilemmas, which focus on the issues of administrative organization goal setting, resource allocation, measurement of effectiveness, and establishing a process for long-range, comprehensive decision-making;

-- Interdependent policies and programs, both public and private, which may result either directly or indirectly in environmental degradation, such as programs to promote economic development, encourage resource development, finance transportation facilities or eliminate urban blight;

-- Technical considerations, such as defining environmental quality, monitoring environmental factors, and understanding the working of the ecosystem;

-- Federal and state requirements, which define the legal framework for local governments, set environmental quality standards, and mandate compliance with federal and state procedures (e.g., the environmental impact statement process).

Given the multiplicity of forces at work, organizational arrangements and programmatic responses cannot be standardized, but need to be tailored to local and regional situations. In light of the complex operating framework and the development of many new environmental programs, local and state officials are uncertain about which programs are available and how effective they have been or potentially could be. Most of the literature to date has not addressed itself to solving environmental problems at the local and regional level. Instead, for the most part, the focus has been on polemic-style essays forecasting doom, descriptions of environmental crises and their consequences, pleas for broad national policies, or technical information regarding the functioning of the ecosystem. They do not address how a manager is to bring together the technical knowledge and the managerial skills for developing and implementing environmental programs.

This anthology is designed to help fill that void by focusing on the topic of "managing the environment." The purposes of the anthology are: (1) to define and gain insight into the nature of environmental problems; (2) to discuss strategies for managing the environment; and (3) to analyze the forces that effect "environmental managers" as they attempt to develop and implement environmental programs.

The anthology is divided into six sections: The Nature of the Environmental Crisis; Perspectives on the Environment; Organizing for Environmental Management; Local Strategies for Managing the Environment; Environmental Technology; and Intergovernmental Relations in Managing the Environment. The anthology begins with an overview of the environmental crisis which analyzes the present conditions in the biosphere, the social, political and economic costs of pollution, the residuals of production, and the dynamics of the ecological system. The second section presents three perspectives--environmentalist, business, and environmental manager--on the environment. Next the anthology addresses the subject of organizing for environmental management, looking at the special demands environmental management makes on an organization, the legal and institutional framework, and some types of regional approaches. The fourth section reviews a variety of strategies or tools which can be adopted to improve environmental quality. These include: comprehensive planning, land use controls, environmental impact assessment, environmental quality standards, economic incentives and penalties, and legal actions taken by citizens, private industry, and government. The fifth section discusses two recent technological developments: the development of a decision-making model which evaluates alternative courses of land use actions, and the development of an environmental information system which organizes data about the environment for use by managers. The anthology concludes with a section on the intergovernmental aspects of environmental programs. Various officials representing different levels of government discuss their perceptions of environmental problems and give their views on managing the environment within the federal system.

# PREFACE TO: I. THE NATURE OF THE CRISIS

What is this crisis with nature that has recently come to the fore of national problems? Efforts to analyze pollution as well as to devise means to prevent it typically involve economics along with politics and science. The complexities of preserving or enhancing environmental qualities cannot be denied; hopefully, they can be better defined and better understood. In the following pages, the subject of the environment is explored from various specialized perspectives.

In his article entitled "Pollution: the Mess Around Us," Marshall Goldman describes how pollution, once merely an annoyance, has in the last few decades reached a crisis or state of "environmental disruption." Such disruptions result from a combination of factors, the key determinants being (1) population explosion, (2) unparalleled affluence, (3) technological progress and (4) major incidents affecting the health and well-being of large numbers of people (e.g., proneness to respiratory ailments from heavily polluted city air).

Among the complicating factors in controlling air and water pollution is that no single person or organization is usually considered to be the owner of the air or the water. Usually, these natural resources are considered available to whomever wants to use them. Since these resources are often treated as "free goods," according to Goldman, it's difficult to determine the value of either clean or dirty air and water.

That ecologists and planners have much to learn from each other is the theme of the article "The Nature and Behavior of Ecological Systems," jointly authored by C. S. Holling and M. A. Goldberg. The authors comment on the complexity and resiliency of both the natural and man-built environments, and they note that complexity is worthwhile and should be preserved and acknowledged.

For example, the authors cited the use of DDT for malaria control in Borneo in the 1960's from which significant disturbances in the natural balance of certain predatory and parasitic creatures resulted. The example illustrated the variety of "interactive pathways that link parts of an ecological system, pathways that are sufficiently intricate and complicated so that manipulating one fragment causes a reverberation throughout the system."

The authors single out four essential properties of ecological systems, which help us understand the nature of such systems. They are as follows:

1. Ecosystems are characterized not only by their parts but also by the interaction of those parts. Because the interactions are so complex, it is dangerous to take a fragmented view or look at an isolated part of the system.

2. Ecological systems have not been assembled mechanistically, but have evolved in time and are defined in part by their history.

3. Complex ecosystems have very significant spatial interactions; just as they have been formed by events over time so are they affected by events over space.

1

4. There are a variety of structural properties of the processes that interrelate the components of an ecosystem.

While the special characteristics of the nature and behavior of ecological systems differ from those of urban systems, an analogy can be drawn. In terms of definition, ecology is the study of the interactions between organisms and the physical environment; planning concerns itself with the interaction between man and the environment of which he is a part. According to the authors, the real substance of an analogy between ecological and urban systems lies in the fundamental similarities in the structure of entire systems.

A basic task of environmental planning and management is how to determine the use of environmental resources and to allocate them through non-market mechanisms. In his article "Residuals and Environmental Management," Blair T. Bower examines a critical obstacle for environmental management, that is, the eventual disposal of residuals or "leftovers" of production and consumption. After reviewing the basic properties of residuals, Bower explores the key issues and societal choices they reflect. He concludes by noting not only the interrelationship between residual and environmental management but also the relationship of other sectors of the economy to environmental planning and management.

# POLLUTION: THE MESS AROUND US

Marshall I. Goldman*

## Pollution Through the Years

Pollution has plagued mankind for centuries, and we all know what it is. But the word itself is often used to cover a variety of sins. Before we can talk intelligently about it, we should try to define what we mean. Actually, what we have had is environmental disruption. There is virtually no naturally pure water and air and most of us would not know what to do with pure air and water if we had it. Pure oxygen, if that is what we mean by pure air, would make us giddy, and pure distilled water would have no taste.

Even if pure air and water had existed at one time in a natural state, the mere presence of human beings and animals would be enough to alter those conditions. Such changes, however, are not serious unless they radically disrupt the existing balance or make the environment unfit for other organisms. Even then, it is necessary to distinguish between impurities, which make water and air economically or aesthetically undesirable -- and may also destroy some forms of flora or fauna -- and contaminating substances, which endanger the health of human beings.

That undesired changes were taking place in the water supply was recognized by the Romans before the first century B.C. Because the sewage generated by a city of about one million people endangered the drinking water, the Romans built one of the first major municipal sewers in history, the Cloaca Maxima. Venice, after all, was and is nothing but a sewer in search of a city. Until new construction recently disrupted the age-old water circulation pattern, the city flushed its sewage effortlessly into the sea twice a day by using the natural flow of the tides. In the north, Richard II of England as early as 1388 banned the throwing of filth into the Thames. Later generations, however, were ignorant of such necessities and dumped their sewage whenever and wherever convenient. The result was dysentery and periodic epidemics of such diseases as cholera and typhoid.

Smog has also annoyed man for centuries. Although smog in Los Angeles did not become a burning issue until 1943, in the mid-sixteenth century Spanish explorers landing there noted layers of smoke from Indian fires hanging above the area. In the scientific terminology of today this is called an inversion layer. For centuries England has been similarly plagued by polluted air. As early as the thirteenth century English authorities complained about smoke from coal and charcoal fires. By the fourteenth century the first clean air legislation had been passed, and one man was actually hanged in London for violating the law. Apparently such laws later fell into disuse. This is indicated in an appeal addressed to Charles II in 1661 by

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*Marshall I. Goldman, Ph. D., is Professor of Economics, Wellesley College. Reprinted by permission of Prentice-Hall, Inc., from CONTROLLING POLLUTION: The Economics of a Cleaner America, copyright 1967, pp. 3-31.

John Evelyn, entitled "FUMIFUGIUM or the Inconvenience of the Aer and SMOAKE OF LONDON. Dissipated Together with some REMEDIES humbly proposed By John Evelyn Esq: To His Sacred MAJESTIE and To the PARLIAMENT now Assembled. Published by His Majesty's Command." Charles Dickens' England continued to suffer from sunless skies and smoky moors. Ironically, the English government during World War II encouraged smoke emission in order to obscure bombing targets from the Germans.

Still, despite isolated examples, until the beginning of the twentieth century man has been able to coexist with his waste. There was little or no interference with nature's self-regenerating system. Generally harmonious proportions were kept among such living organisms as human beings, vegetation, and animals. Moreover, since there had been little experimentation with the earth's minerals, almost all waste decomposed rapidly or served as nutrient or raw material for other forms of life. For example, kitchen garbage was nicely disposed of by the livestock usually kept for human consumption. The circle seemed to be perfect.

By the late nineteenth century, however, the careful observer could find some disproportion in the circle. Pollution, which for centuries had not been especially offensive, gradually became intolerable in a growing number of places. In the years following World War II there was no longer any doubt that the circle had popped and left gaping holes out of which an increasingly alarmed population gasped for fresh air and water.

## An Annoyance Becomes a Crisis

In this country the emergence of concern about environmental disruption has been caused by a combination of developments such as (1) population explosion, (2) unparalleled affluence, (3) technological progress, and (4) major incidents affecting the health and well-being of large numbers of people.

1. Since World War II the world's population has been expanding at an exceptionally rapid rate. Paul Ehrlich of Stanford University points out that world population doubled during the two hundred years between 1650 and 1850. The next doubling took eighty years, and now it takes only thirty-five years. Moreover, it is not just that there are more of us, but that we are clustered in ever more compact areas. Kingsley Davis estimates that 40 percent of the world's population live in urban areas; 50 percent or urban dwellers live in cities of 100,000 or more. Naturally the more people there are, the more wastes there are to recycle. The concentration of people and their accompanying wastes makes the task of recycling and disposal all the more difficult. In the past, water, air, and solid wastes were discharged in small, easily diluted doses; now wastes are collected in large sewage complexes, tall chimney stacks, or sprawling dumps that are invariably overtaxed. The same disposal problem was created when livestock was taken from wide-open ranges and farmlands and herded into feed lots. Although once manure served as the main source of fertilizer, now much of it has become a mess to be disposed of as expeditiously and odorlessly as possible. Chemical fertilizer now accomplishes artificially what used to be done naturally.

To escape the crushing throngs in the cities, people formed a mass exodus to the suburbs. Large numbers of people apparently decided that they did not like being crowded together in the city; if they were going to be crowded, they decided that it was much better to crowd together in the suburbs. Green spaces began to disappear; before long airplane pilots and geographers found themselves unable to distinguish where one town ended and another began. Vast portions of the countryside from New Hampshire to Virginia became one continuous suburb, which Jean Gottman called "Megalopolis." This term may also come to describe the area from Los Angeles to San Francisco and from Chicago to Detroit or from Chicago to Pittsburgh.

As the population grew and increased its mobility and its discharge of refuse, natural facilities for transforming waste began to disappear. Factories and stores moved outside of the cities, brought with them highways, asphalt parking lots, and demands for water and air. To the regular wastes of consumption and production in the cities were added the remains of buildings demolished under urban renewal programs. In many areas it became harder and harder to find natural preserves in which to process or absorb smoke and liquid and solid wastes.

2. The population has grown not only in size but also in wealth. With per capita income reaching historic heights, production has risen to satisfy growing demands. This production increases consumption of natural resources for industrial purposes, which in turn generates greater waste from the process of manufacturing and mining itself.

It is not only from the production of goods that wastes are multiplied; it is also in their consumption. The richer we become and the more we can consume, the more we have to throw away. Furthermore we somehow decided that it is now convenient to buy something and throw either it or its container away. Today almost everything is disposable, from diapers to dresses. We now even have disposable disposables. Unfortunately the use of such disposables is not the final solution to our solid waste disposal problem. Our cast off purchases must be put somewhere. Even if a product is utilized for a long period of time (a piece of furniture, a car, a television set), ultimately it will be discarded in some form -- usually as junk. Ultimate disposal results in the disintegration of a product into its elemental components, as with the disgestion of food or the burning of fuel. Our wastes must end up in the water, on the ground, or in the air, generally in a form making them unsuitable for further use.

The magnitude and complexity of the disposal problem is best illustrated by the complications that have arisen out of the production and consumption of the automobile. Affluence, the automobile, and aggravation seem to go together. For example, automobile exhaust is now the major cause of air pollution in many of our larger cities. Annual automobile production has risen from 3.5 million in 1947 to 9 million in the 1960s. The fumes produced annually by the almost 110 million combustion engines of America's automobiles, trucks, and buses are estimated to be 90 million tons of gases, including 64 million tons of carbon monoxide.[2] This constitutes 40 percent of all air pollution emissions and 60 percent of all carbon monoxide released into the atmosphere. The carbon monoxide alone is enough to poison the combined air space of Massachusetts, Connecticut, and New Jersey. The automobile is the king of American consumer goods, and it is also a complete portable factory. Every vehicle generates power and air exhaust just like a miniature thermal electric plant. Crossing behind a jam of cars stopped at a red light is a bit like walking behind a series of upended chimney stacks -- all pointing in your direction.

Of equal importance, automobile junking, like the disposal of other consumer goods, has become a serious problem. Every year approximately 7 million vehicles are scrapped and must be discarded somehow. Fortunately many cars and trucks are recycled in the form of used cars and trucks a few years after their initial purchase, but ultimately even these vehicles must be removed from the streets. At one time this removal posed no difficulty; but beginning in the late 1950's, automobiles started to pile up in city streets and in automobile graveyards across the country.

The metamorphosis of the discarded auto from a depreciated but still treasured pet into a valueless white elephant is a classic illustration of how changes in technology and economic factor costs combine to effect environmental disruption.

Until the early 1960s steel was produced almost entirely in open-hearth furnaces. The metal charge fed into these furnaces often consisted of as much as 50 percent scrap iron along with the raw iron ore. Accordingly, used automobiles were sought after by junk dealers because of the value of the scrap metal. Despite the fact that other metals, such as copper and aluminum, were sometimes included along with the scrap steel in the melted mass, the technology of the open-hearth furnace was such that the quality of the steel it produced was not seriously affected.

Because both its construction and operating costs were often one-half as large as the oxygen (LD) process of making steel, more and more American steel manufacturers began to close down their open-hearth furnaces and replace them with oxygen furnaces. Unhappily for the junk dealer, oxygen furnaces had a much lower tolerance for impurities and could take no more than 30 percent scrap in their metal charges. Inevitably the steel manufacturers began to substitute iron ore and taconite pellets for scrap. This in turn caused a drop in the price of scrap and the value of the junked auto.

The increase in national wealth produced a keener awareness of pollution for yet another reason. More wealth brought with it not only more products but also more leisure, making it possible for people to become aware of and to explore the countryside. More and more they found that what was left was becoming polluted. Invariably, this made an indelible imprint. A famous Michigan labor leader unexpectedly asked to testify before antipollution hearings conducted in Detroit. Since this particular leader had never taken much interest in pollution control before, he was asked to account for his sudden enthusiasm. He sadly explained that after years of hard work, he finally managed to buy a summer retreat. To his dismay, within a few years, the lake adjacent to this cottage had become polluted; from Shangri-la to cesspool. As one government official explained it, "This is how we win our most ardent supporters."

3. A third factor influencing the seriousness of the pollution problem has been the rapid advance in industrial technology. It is not just that there are more of us and that each of us consumes more than did our fathers and grandfathers; it is also that what we consume is more complex in its material makeup. Each day products of an ever more exotic and synthetic nature are invented and distributed. It is estimated that 500 new chemical compounds are introduced by industry each year. Frequently these newly-discovered compounds are not biodegradable--readily broken up into easily digestible or disposable by-products. We may live better thanks to chemistry, but the products that result often live on long after the users are gone. Some products, such as aluminum tin cans, are virtually indestructible. The old steel tin cans at least rusted and disintegrated after a time. Unhappily, manufacturers are moving further and further away from products and containers like ice cream and its cone, ideal from the point of view of pollution control because they self-destruct in the process of consumption. Instead, both manufacturers and consumers are encouraging the use of permanent plastic cups and non-returnable bottles, which means greater convenience for the consumer but more litter on the picnic ground and roadside.

The tendency is to blame manufacturers for the switch to nonreturnable bottles. In fairness, it is as much if not more the fault of the consumer. The bottlers began to switch when they found that their customers were failing to claim their deposits for returnable bottles. From an average of fifty round trips per bottle in 1955, returnable bottles were making only about ten trips in 1970. Many bottlers simply abandoned the use of returnable bottles altogether. Thus there is no longer monetary compensation for most bottle returns. The withdrawal of the economic incentive, small as it is, has simply accelerated the accumulation of clutter.

The effects of technology have been even more serious in other fields. Deadly pesticides and industrial wastes are composed of chemical derivatives that do not always break down easily. That, in fact, was what once made them so attractive. DDT sprayed on a plant did not dissolve and lose its effectiveness. As a result, malaria, one of the worst scourges of man, was virtually eliminated in vast parts of the world and DDT was regarded as a major boon to mankind.

The soap industry is a prime example of how the thoughtless use of technology can disrupt the environment. In an effort to improve the cleansing impact and lower the cost of the product, the soap industry switched from a fat base to a nonbiodegradable detergent base--one that does not readily break down in the normal course of sanitary treatment. Consequently, pools of froth began to cover drinking water reservoirs, and floods of suds frequently returned to the household through the kitchen faucet.

We should remember that the initial stimulus to the development of both pesticides and detergents was a positive one. The well-being of mankind was to be advanced through the use of technology. It was assumed on the one hand, that health could be improved by eliminating the causes of disease and on the other hand that costs would be reduced and convenience improved by a switch to labor-saving but capital and environmental intensive products and processes. An important lesson to be learned from the outcome is that our heightened ability to tinker with technology may sometimes lead to unexpected and unfortunate results. The likelihood of such unanticipated consequences becomes all the greater as we industrialize and our ability to manipulate technology increases. In our efforts to improve on nature we sometimes find ourselves upsetting the ecological balance with potentially disastrous consequences. Invariably the engineers rush to our rescue with new solutions to the new problems we have created but in a short time we often find that their newest solutions have in turn generated a new set of difficulties.

The balance in the future, when still unanticipated difficulties may arise, is even more uncertain. We must recognize that as we increase our technological ability to "compensate" for nature's shortcomings, we are likely to find that the potential for negative by-products may increase even faster.

4. Finally, concern about environmental disruption has attracted additional support after a sequence of serious incidents. Because medical science has found more and more cures for our more traditional disease-causing enemies, we have become more prone to other ailments. Not suprisingly therefore, many people, especially the elderly, find themselves becoming affected more and more by pollution in the environment, especially the air. Thus poor air has been blamed for cancer, pneumonia, bronchitis, emphysema and tuberculosis. Scientists point out that by breathing the air in New York City, one inhales an amount of cancer-producing benzopyrene equivalent to smoking one or two packs of cigarettes a day. It is further claimed that air pollution is responsible for the 80 percent rise in deaths from respiratory diseases from 1930 to 1960.

Clearly delineated surges in the death rate have been traced directly to air pollution. Such incidents have occurred in Donora, Pennsylvania, in October 1948 when the death of 19 and the illness of 6,000 of the town's 13,800 citizens were blamed on smog. Smog was also blamed in London when the normal death rate rose by 4,000 in December 1952, and when 8,000 died prematurely in January and February 1953. Similarly air pollution was considered a major cause of death in New York City in

January and February 1963 when there were 647 more deaths than normal. Some scientists also cite air pollution as a factor contributing to street riots in some of our large cities. In addition to the normally expected discomfort, pollution is said to generate depression and melancholia. As for water pollution, in 1965 at Riverside, California, 18,000 people were afflicted with gastroenteritis from the town's water wells, and three apparently died as a result. In Japan forty-five residents of Minamata died from mercury poisoning of the water in the 1950s and 1960s. In the 1970s fears of similar incidents spread throughout the rest of the world as some fish were discovered to have excessively high mercury content. Even when no loss of life results, the massive environmental disruption that stems from disasters such as the sinking of the Torrey Canyon or the oil spills off Santa Barbara focuses world attention on the destruction we can inflict on one another, and more than anything else heightens our awareness of the problem.

## Why Do Polluters Pollute?

It is not difficult to understand why there is pollution of the air and water and even the land. Moreover it is not just industries and municipalities that are contributors. Some of your best friends insist on using their own septic tanks or cesspools rather than linking up with a public sewer system for the disposal of household sewage. Unless the soil conditions are suitable and the homes are located at sufficient distance, this could contaminate the ground water. When did you have your last cookout or throw a beer can on the beach or highway? Did you ever leave the car motor on while running an errand?

Few people stop to consider that they are polluters when they do such things. And if they recognize that they are creating some form of air, water, or solid litter, they always say to themselves that their little bit of waste will not make much difference. In addition it would cost more to have someone haul the trash and leaves away; it might be prohibitively expensive to link up a house with a sewer system. Similarly, industries and municipalities follow the same reasoning: it is cheaper, it is more convenient. Economists call the pollution which arises from such a situation an external diseconomy. To the polluter there never seems to be great harm in just his little pollution, but there may be great expense to society as a whole when it tries to clean up the wastes of many such polluters.

The waters are usually so plentiful and the sky so vast that it is hard to believe one person can cause pollution. In fact, one person usually cannot cause pollution; it is when there are numerous "one persons" who all think the same way that pollution results. Moreover when one person pollutes, he himself is not usually the one to suffer or bear the expense. In fact the private cost to the individual is most often cheaper if he does pollute than if he has to use expensive disposal equipment. If the water is polluted, it is the people downstream who are affected. If the air is polluted, it is the people in the direction of the wind. This is an instance where the private costs of pollution are almost always less than the costs to the rest of society. Pollution results from pushing off what should be your responsibility onto someone else who is usually anonymous. The effects are spread over such a wide area and affect so many people that generally no individual suffers enough damage to induce him to exert the effort needed to seek out and collect from the offender. Furthermore, the compensation that might be obtained from suing the offender and preventing future damage may not be worth the effort and cost involved.

There are exceptions. This becomes apparent if we divide the social costs into two categories: those that fall on the population as a whole and those that fall primarily on other producers. When the social cost of an operation is spread thinly over the entire area, no one may feel sufficiently damaged to take corrective action. However, if the smoke or discharged water from a particular factory moves downwind or downstream to an adjacent factory, the adjacent factory may feel the effects so severely that the polluted air or water becomes a direct cost of operation. In this case, the downstream or downwind factory is more likely to take action to force the offender to absorb and bear his own social costs.

This can lead to some peculiar situations. The Everett Station of the Boston Edison Company draws on water from the Mystic River for use in its boilers and for cooling. Unfortunately, a Monsanto chemical plant is located slightly upstream from the generating plant and discharges various chemical wastes into the Mystic River. This makes it necessary for Boston Edison to provide extra treatment for the water it uses. Therefore Boston Edison supports all efforts to force Monsanto to clean up its effluent. At the same time, however, until recently Boston Edison dragged its feet when others urged a reduction in sulfur and particulate content of the air discharged from its chimney stacks. To do this, it argued, would increase its costs of operation.

For the most part, however, it is usually quite difficult to assign and assess responsibility for damages in cases of external diseconomies. For example, if a second factory decides to locate next to a factory that has been polluting for decades in splendid isolation, away from all industry and homes, should the original factory be made to bear the cost of cleaning up the pollution? Why should this factory suddenly be made to pay for something it has been doing for years without visible or sufficient economic damage or complaint until the neighbor moves in alongside? Moreover if several polluters are located along a lake or are affected by one another's smoke when the wind shifts, who should bear the responsibility--the most recently completed factory? Its smoke or water may have caused the ecological system to break down, but is it ultimately to blame? In other words, who is responsible--all the men who have put straw on the camel, or just the last man before its back is broken? Clearly it would be unfair to compel the new firm to purchase expensive pollution control equipment and allow the older firms to produce waste as freely as before. This would put the new firm at a competitive disadvantage and would also discourage the location of new industry in the neighborhood. Yet if the old firms were required to buy pollution control devices, they might move out to other areas which were more permissive. Similarly, factory management could argue very persuasively that even if hundreds of thousands of dollars were spent to clean up wastes, the pollution problem might still exist unless the other firms and town in the area were also forced to clean up their waste. Management would have to justify such expenditures to stockholders who might wonder if such expenses are warranted when they add absolutely nothing to sales revenues. Viewed from the perspective of the industrial unit such expenses are nonproductive and, if anything, benefit primarily the downstream or downwind company or town.

Obviously in such circumstances the traditional price mechanism that we rely on to guide us in the production and distribution of most of our natural wealth can do nothing to solve the problem. Normally through the market system, prices are used to balance off the demand pressure for a product with all the production costs involved. In this way goods can be purchased by those who are willing and able to pay a high enough price for them. This, we say, shows that private costs equal private benefits. It should be pointed out that the concepts of private costs and private benefits are not peculiar to nonsocialist societies. They also exist in the USSR, since Soviet enterprises and cities are held responsible only for their private costs, or charges that can be specifically and directly assessed to users of the input. As in the United States, no one in the USSR has been able to break down social costs and attribute them precisely to their source. And despite a faulty price system in the USSR, when two inputs are equally productive, the factory manager in both the

United States and the USSR will use more of the input that is cheaper. For example, if wages are relatively cheaper than rents, he will use more labor than land. In other words, given a certain level of production, a manufacturer will use that mix of inputs that will cost him the least.

The price a factory manager is willing to pay also indicates that he usually expects to receive at least that much benefit from the product. Each productive resource is used until the cost of an additional unit is just equal to the extra revenue that resource will bring to the producer. When all products react in the same way, then the price that must be paid for the productive resource will tend to equal the value of the product which is produced.

If demand for a good increases, the price will be increased. This in turn should induce an increase in production. Prices will rise also if the raw materials used in the production process become harder to find, or if workers suddenly decide they would rather work elsewhere. When the costs of production factor inputs are increased, the manufacturer tries to pass this on to the consumer by raising the sale price. It also happens in most instances that when the cost of production rises, it is necessary to cut back production to make sure that there is no overproduction. Higher prices usually mean fewer purchasers.

It is also essential, if the price system is to function properly, that someone or some group control and sell or otherwise allocate all the factors of production. Thus, whether they be landlords, bankers, laborers, or managers, fees are collected for the use of an input which presumable provide proper compensation for the cost of reproducing the article or for the revenues foregone by not taking advantage of opportunities available elsewhere. In this way, the costs of all inputs used in the production process are properly identified. Thus we can say that private benefits and costs equal social benefits and costs since no resource is utilized unless someone is compensated for it at a rate which usually will reflect the demand and supply pressure for the good.

One of the reasons that air and water pollution is hard to control is that no person or organization is normally considered to be the owner of the air and water. With few exceptions such resources are considered to be readily available to those who want to use them. It is difficult to attach a value to either clean or dirty air and water. They are often treated as if they are free goods.

The price system cannot be expected to function properly, however, if the factor inputs are priced improperly or are not priced at all. If a factor is overpriced, this will lead to the increased price of the final product and a reduction in the amount sold. Conversely, if the factor is underpriced, then the selling price will not reflect the full cost to society of all the inputs that are involved, and more of the good will be sold than should be. At the same time, more of the resource will be used in production than if only the price of the factor properly reflected the alternative used to which it might be put.

Abuse of water and air resources comes about then largely because air and water are undervalued. Air and water are regarded as free goods. For example, officials in New York City have long resisted the plea of economists and conservationists that meters be installed to measure all household use of water. Since there is no economic incentive to conserve water, there is great waste. In other words, no effort is made to "economize." Without exception, the failure to attach a proper value to something like water results in increased consumption. When water meters and water charges were introduced throughout all of Philadelphia in 1960, water consumption declined by as much as 28 percent. All too frequently we have failed to distinguish between rain and readily available drinking water and between air and fresh air. As one critic has said, it is as if there had been no differentiation between grass and milk.

The mere imposition of a fee for the use of air and water, however, does not guarantee an end to their irrational use. There is still the risk of excess consumption if the fee is not directly related to the benefits or cost of using the water. This can best be illustrated by an example. Assume that 100 people agree to share a phone and the phone bill. Each person would feel strongly tempted to make an unlimited number of long-distance calls because he would have to pay only 1/100th of the bill. Unfortunately, each of the other participants would feel exactly the same and the result would be a flood of long-distance calls and an unusually large phone bill. We abuse our air and water resources in exactly the same way. Even when there is a fee for water usage and sewage discharge, the fee is often understated or subsidized with income from some other source. If, however, the price of water were increased, it would become a more valuable commodity and therefore more care would be taken to utilize it efficiently.

## The Social Costs of Pollution

Because they are generally considered to be nonmarketable products, it is difficult to evaluate the costs of polluting water and air. Cost in this context refers to the damage that arises because of environmental disruption; the question of how much it would cost to remedy environmental disruption will be considered next.

Cost estimates of damage caused by pollution are hard to make. Various estimates are tossed around, but generally they are not based on solid research or calculation. Moreover once a figure is suggested by someone, it is often grabbed by everyone else until gradually it is accepted as the basic truth. In time the original source and the qualifications surrounding the calculation are forgotten and only the basic figure remains. Yet before there can ever be a workable solution to the pollution problem, some estimate of the cost of the damage from pollution must be made so that proper values can be assigned to air and water. The task is made even more complex because so many things affected by pollution--swimming in a river or smelling clean air--are impossible to price. Even when pricing the damages is no impediment, a decision must nonetheless be made as to how far back the researcher should go in counting up the damages. Does one include just the primary effects or the secondary and tertiary damage as well? If smoggy air necessitates the closing of an airport, should one count not only the loss in revenue from the inability of planes to fly but also the business transactions that were not consummated because salesmen were unable to reach waiting buyers?

It also happens frequently that damage arising out of some act only becomes apparent years later. For example, it has taken about twenty years for us to realize the extent of the harm caused by the use of DDT. We should reckon from the first use of the insecticide if a proper accounting of the costs is to be made. Also it is not always easy to ascribe correctly an economic loss to pollution. A house in a factory district may be priced low but how much of this is due to pollution and how much of it is due to environmental factors which might also exist in the area? Finally, how much crime and other abuses are due to pollution which hastens the exit of more socially responsible elements of the population?

There are countless illustrations of the difficulty of providing a measure of the cost of pollution damage. Because of emissions of industrial waste into Lake Michigan from Chicago's South Side, it was necessary to close several beaches on the lake in 1965 and 1966. It turned out that Blacks were the predominant users of two or three of these beaches. When the industrial and municipal polluters complained about the cost of an accelerated cleanup schedule, federal authorities replied that failure to reopen the beaches might touch off race riots. Such riots would be directly attributable to the withdrawal of recreation facilities because of the pollution, and the blame would rest squarely on the shoulders of the polluters. Whatever the material costs that might have resulted from the damage and the additional costs necessitated by travel expenditures to other swimming sites, and the building of substitute swimming pools, the polluters apparently agreed that there were also political and public relations costs involved which more than justified expensive remedies. The accelerated cleanup program was accepted.

Other costs of water pollution should include estimates of the damage suffered by the fish industry. The shellfish industry is claimed to have suffered a $45 million loss because water pollution in tideland areas led to the spread of hepatitis through the clam and oyster beds. Estimates can also be collected of the losses suffered as a result of the destruction of sword- and tunafish arising from the mercury poisoning scare of 1970 and 1971. Tons of such fish were ordered withheld from sale and untold monetary losses resulted from price reductions caused by customers' avoidance of the uncontaminated fish on the shelves.

Many other estimates of cost must be handled in an equally arbitrary fashion. What value should be placed on the premature death of an engineer from asthma induced by polluted air? Is a retired engineer who dies worth as much? What is the cost to society of "blue babies" who suffer from methemoglobinemia? This results when oxygen is boiled off from polluted water used to make baby formulas so that what remains contains increased quantities of nitrogen, which has an adverse effect on the stomach and bladder. What is the cost of mercury poisoning? How does one determine the value of the 116 Japanese citizens who were paralyzed or killed by mercury poisoning at Minamata? In addition to the expenses of medical care, should we also calculate the loss in earning power of pollution victims in the years to come?

Somewhat less tenuous but still arbitrary are the estimates of the losses due to plant closings or relocations because of pollution. Even more questionable are the estimates of the losses from industries which decide not to locate in an area because of pollution. For places like New York City, these are vital but obviously difficult questions to evaluate. Estimates of this nature have been made to show that the benefit to Pittsburgh of clean air would offset the costs involved in trying to clean it. Whatever losses due to industries that left Pittsburgh because they could no longer use the skies as sewers were more than offset by other industries and institutions newly attracted to or contented to remain in a cleaner Pittsburgh. Today Pittsburgh is a city with a revitalized economy. Moreover what was once America's smokiest city now has air quality that is comparable to most American cities of its size.

A specific case of air pollution's effect on the costs of operation of a firm is illustrated by what happened to the companies that fill air tanks for scuba divers in New York City. Public health officials suddenly realized that the air tank companies were compressing polluted New York City air into their tanks. It was bad enough for those who have to breathe New York air in more relaxed circumstances, but to have to breathe it in concentrated form several feet under water was obviously dangerous. Accordingly, the New York City Air Pollution Control Act of May, 1966, prohibits the sale or distribution of compressed air tanks for underwater breathing use without special permits. The cost of air pollution in this case could be measured by ascertaining how many compressed air companies have been forced to close their doors and how much existing firms have had to spend in new equipment necessitated by the new law.

In the same category of cost estimates is the loss to the optical industry that comes from the difficulty of selling contact lenses in a city like New York. Doctors there have found that it is extremely dangerous for their patients to wear contact lenses for any length of time because of the possibility of lacerations to the eye. Specks of dirt and ash are periodically caught between the retina and the lens. Presumably the loss entailed from this could be calculated by determining the per capita use of contact lenses in other less polluted cities and then comparing this with similar ratios in New York City. To this should also be added the cost of eye surgery necessitated by pollution.

Attempts have also been made to evaluate any additional living costs for a family in an air-polluted area. In one of the few systematic studies ever made, Irving T. Michelson of Consumer's Union in New York City estimated that a family owning its own home in New York paid over $800 (or $200 per person) more a year than a family located in a less polluted area. He estimated that families living in apartments pay on the average of over $400 more. This includes added expenditues for household maintenance--extra painting, cleaning and washing, extra laundry bills--and extra medical expenses, replacement of clothing, fewer sunlight hours, and lower real estate values.

Michelson's figures may be a little high compared to $65, the figure most commonly cited as the cost of air pollution per capita in the United States. Unfortunately no one really knows whether Michelson is high, low or in the middle. One of the most embarrassing acknowledgements that economists studying environmental disruption should make (and often don't) is that so few studies have been made of the cost of air or water pollution. Some economists have tried to determine the effect of air pollution on land values, and one or two pioneering efforts to determine costs have been made, but the results so far suggest that no one need worry that the subject has been exhausted.[1]

The estimates of losses endured because of environmental disruption are not much better than estimates of the cost to eliminate environmental disruption. Almost all the same statistical hazards also apply here, and there are also several extra pitfalls. First, there is confusion between the costs required to construct an adequate treatment system and the costs of operating that system--often the figures are used without making any distinction. Second, it is not always clear just what the elimination of environmental disruption would mean. Thus when speaking of water treatment, is the goal secondary treatment or the more elaborate tertiary treatment? Primary treatment of one thousand gallons of water with removal of one-third of the Biochemical Oxygen Demand (BOD) costs about 3-4¢ per thousand gallons.[2] (For a definition of BOD and an explanation of what is involved in the various stages of treatment, see the Goldman and Shoop article in Part I.)* Secondary and primary treatment of a similar quantity of water, in which 90 percent of the BOD and about one-third of the nitrogen and one-third of the phosphates are removed, costs about 15-20¢. Another 15-20¢ must be added for the tertiary treatment of water, so that total costs amount to 30-40¢ per thousand gallons.[3] But we are a long way from reaching the goal of even secondary treatment in the United States. Currently the homes of 70 percent of our population are served by some kind of sewer system. However the sewage from about 7 percent of these homes (involving 10 million people) is discharged directly into our water courses as raw sewage. Only about 43 percent of the American population (about 85 million people) is served by secondary sewage systems.

*This is a reference to Part I of the orginal publication of this article: CONTROLLING POLLUTION: The Economics of a Cleaner America.

For many people living in isolated areas there is no need for secondary treatment or even for sewers. A septic tank or even an outhouse may adequately treat such waste if the site is isolated enough. (In effect, this is nature's way.) As people continue to crowd into urban areas, however, the need for sewers and secondary treatment grows. The Federal Water Pollution Control Agency (now the Water Quality Office) estimates that by 1974, 90 percent of our urban population will need secondary sewage systems. To bring us up to that level, expenditures of over $10 billion in water treatment plants (exclusive of land costs) and over $6 billion in sewers will be required during the years 1970-74.[4] To separate storm and household sewers could cost anywhere from $15 to $50 billion.[5] Construction of secondary treatment facilities for industrial wastes will require close to another $5 billion, and control of sediment and acid drainage from mines could require from $2 to $5 billion. To control thermal pollution (overheating the water by discharging water used for cooling) will cost yet another $2 billion although heightened standards may soon necessitate a figure as large as $4 billion. This would bring the total investment required for industry to something like $9 and $14 billion. Total capital requirements for secondary treatment of water therefore will probably range between $40 and $80 billion. The Federal Water Pollution Control Administration estimates that annual operating costs for all these facilities would reach almost $2 billion for municipal plants, $3.5 billion for industrial plants, and about $1 billion for thermal processes.

If we were forced to move to tertiary treatment, the total for all construction costs in Table II would probably jump from $40 billion to about $90 billion. Even if very few American cities decide to move to tertiary treatment and only a few spend the money to separate storm and household sewers, it is still easy to see why some authorities estimate the ultimate cost at close to $100 billion.[6]

It is necessary to remember that not all of this expense is incurred at the treatment end of the process. Large sums of money will also have to be spent periodically by manufacturers to alter their product mixes to make them less destructive to the environment. For example, it is calculated that the shift to soft or biodegradable detergents cost the chemical and soap industry over $100 million. Such a move was ordered in Germany in October 1964, and later adopted by individual American states like Wisconsin because more and more sewage plants found they could not eliminate the growing sea of suds in their sewage. Finally in July 1965, the whole American chemical industry started to make detergents out of linear alkylate sulfonite instead of the hard alkyl benzine sulfonite, that could not be decomposed easily in most sewage treatment plants. About five years later the soap manufacturers were faced with the need to spend millions of dollars more to make another set of changes. This time the focus was on the reduction of phosphates in the detergents. The usual secondary treatment system is unable to remove sufficient quantities of phosphates from the water. Since phosphates are also used as fertilizer, the discharge of large quantities of phosphates into the water has had the effect of stimulating the rapid growth of aquatic plant life. This has increased the spread of algae and seaweed, which in turn eat up the oxygen in the water, hasten the formation of swamps, and accelerate the demise of the water course. (Technically this is called eutrophication. What is happening to Lake Erie is a prime example.) While one solution to this problem would be to build tertiary treatment plants across the country, the cheaper approach is elemination or reduction of the phosphates at the soap factory before they even enter the sewers. Nonetheless the search for a suitable substitute and the alteration of the production process will seriously affect an industry which does a business of about $4 billion a year. Similar examples of how money for pollution control has been spent before the product was produced, rather than on the treatment of the resulting effluent, can be found in the production of paper, where manufacturers stopped using the sulphite process and switched to the sulphate process.

Table II: The Costs of Air, Water and Solid Pollution Control for the Years 1970-1974 (in billions of dollars)

| | Total Construction Costs | Annual Operating Costs |
|---|---|---|
| A. Water Treatment Costs (Secondary Treatment) | | |
| 1. Household sewage | | |
| a. Treatment plants | $10 | |
| b. Sewers | $ 6 | |
| | $16 | $2 |
| 2. Sewer separation | $16 | |
| 3. Industry | $15-$50 | |
| a. Industry treatment costs | $ 5 | $3.5 |
| b. Sediment & acid drainage costs | $ 2-$5 | |
| c. Thermal pollution | $ 2-$4 | $1 |
| | $ 9-$14 | |
| Total Secondary Treatment | $40-$80 | $6.5 |
| Tertiary Treatment | $90-$100 | |
| B. Air Pollution | | |
| 1. Stationary sources | $ 8-$10 ($50-$100)* | $.3-$2 |
| 2. Automobile pollution | $ 1-$ 2 | $2-$3.5 |
| C. Solid Waste | $ 1-$ 3 | $3-$8 |
| Total Pollution Control (Secondary Water Treatment Only) | $50-$95 | $12-$20 |

*The higher figure is for the year 2000.

Another way to calculate the cost of eliminating water pollution is to see how much it would cost to manufacture fresh water. This presumably would represent the outer limit of possible costs, but in some areas reprocessed water is the only alternative source available. Therefore the cost of such reprocessing might serve at least as the upper limit for the value of the water, even though such estimates do not measure the cost of pollution directly. This may be a fairer estimate of the cost of polluting the water, since the practice otherwise is to set the price of fresh water at the amount necessary to cover only the operating costs of the well. Such a system fails to make allowance for the fact that the well may be slowly going dry, as is often the case in the West.

Traditionally attention has been focused on the cost of refining sea water. Given present technology, this is quite expensive. The best desalinization plants can almost produce drinking water at a cost of one dollar per thousand gallons. The facility at the United States Naval Base in Guantanamo, Cuba, produces one thousand gallons for $1.16. This is a considerable improvement over the $14 per thousand gallons that water desalinization cost in 1952. At one time it was hoped that with the aid of special subsidies, an atomic-powered desalinization plant could be built to serve Los Angeles. It was assumed that the subsidies, combined with the revenue from the sale of electric power, would make it possible to price water at about 27¢ per thousand gallons. In late 1970, E. I. du Pont de Nemours & Co. introduced a reverse osmosis system that costs from 25-65¢ per thousand gallons depending on the salinity of the water and the scale of the desalinization plant. Yet unless special subsidies are provided, as was contemplated in Los Angeles, it is unlikely that desalinated water will be cheap enough to compete with the normal cost of well or reservoir water which averages about 15¢ per thousand gallons. However if the cost of sewage treatment is added in, the total cost is closer to about 23¢ per thousand gallons. Some authorities have argued that this cost disparity between fresh water and desalinated water will always exist because scientists are misdirecting their attention toward desalinization. Instead such critics urge that more effort be devoted to reusing sewage water. Sewage often has only 1 percent impurities while sea water has about 3 percent impurities and therefore is harder to clean.

A related problem is the disposal of sewage water. In some areas there is no convenient body of water that can be used as a dumping ground for a city's sewage. This is the problem at Lake Tahoe. If the lake, one of nature's purest, is not to be used as a sewer itself, some other repository must be found. Unfortunately there are no other outlets available in the area so plans have been drawn up to pump the sewage several miles over the mountains. Conservationists in the USSR have argued for a similar arrangement to dispose of effluent from the paper plants on Lake Baikal, but to no avail. The Russian authorities simply argue that it is too expensive.

Santee, California, also had a disposal problem. A treatment plant was built and the water was then further purified by being run over a dried-up riverbed. After a mile of this natural filtration, the water was stored in small artificial lakes stocked with fish and opened to boating. Although unfit for drinking, some of the water is being sold to golf courses for watering the grass. The price is 12¢ per thousand gallons, which is cheaper than fresh water. Since some nutrients are probably still left in the water, this may actually turn out to be a bargain since the water can also be used as a fertilizer.

Estimates of eliminating air pollution are even more complicated. Projected operating costs range from \$300 million a year to \$2 billion and capital costs over the five years from \$8 to \$10 billion.[7] According to the maximum forecast, that would mean capital expenditures of slightly less than \$100 billion by the year 2000. Twenty billion dollars is probably a much more reasonable figure. But these cost figures only cover emissions from stationary sources. Currently, the greatest source of air pollution in many cities is the automobile. A variety of solutions for reducing emissions from the internal combustion engine have been suggested. They include everything from outlawing the combustion engine itself to eliminating gasoline with lead. The cost of the cure varies with the severity of the remedy. There seems to be some agreement (this may merely be a sign that everyone is repeating the original estimate) that proper control equipment and the elimination of leaded gasoline would result in a 10 percent yearly increase in the cost of operating an automobile. The cost per car would be about \$30 a year based on the average per capita expenditure of \$300 a year that Americans spend on their automobiles. For the country as a whole, the total annual outlay could range from \$2 to \$3.5 billion.

Another cause of air pollution is the jet airplane. Generally airlines claim that they contribute only 1 percent of the nation's air pollution. However, the amount of jet pollution varies from city to city and neighborhood to neighborhood, depending on proximity to the airport. New York City reportedly receives one and a half tons of air pollutants a day. As a result of new laws instituted by officials in New Jersey and Chicago, which now allow state officials to exact fines as high as \$5,000 for planes which violate exhaust standards, the airlines have agreed to curb their exhaust emission by 1972. Initially airline officials claimed this would cost $30 million. Subsequently they lowered their estimates to $13-$15 million.

Although it is not indicated in Table II, it is necessary to remember that some of the cost incurred in reducing water and air emission will be offset by savings that come with cleaner air and water. One benefit of cleaner air would be a reduction in cleaning bills and medical expenses. Another saving will result from increased utilization of the by-products of combustion. This will permit greater recycling of nature's resources and will mean less exploitation of new resources. It is estimated that approximately 23 million tons of sulfur dioxide are discarded into the air each year as part of the combusion process. If recovered, this could provide about 5 million tons of sulfur or 15 million tons of sulfuric acid. Although the price of sulfur has fallen in recent years so that recovery is less attractive than it once was, such a program of resource reuse would virtually satisfy the entire demand for some sulfur compounds.

Institution of $50 to $100 billion worth of air quality controls over the next few decades would not mean the elimination of all air pollution, nor of the costs that arise from it. Nevertheless, substantial savings could be realized and therefore used to defray the cost of the annual expenses envisaged as necessary to clean up the air. This could go a long way if not all the way toward offsetting the annual $5 to $13.5 billion in operating expenses that would be needed to curb air pollution as indicated in Table II.

The cost estimates for solid waste disposal are somewhat less complicated but still something less than precise. They are less complicated because in the present state of the art, the technology is even more primitive than it is in water and air treatment. Usually solid waste disposal involves nothing more than an incinerator and often just an empty field and a fleet of dump trucks. Sophistication may mean nothing more than an automobile shredder which may cost $3 million. Under the circumstances, the capital expenditures required for solid waste disposal are negligible compared to the investment required for air and water treatment. Thus to dispose of the estimated 5 pounds a day in household waste discarded by an average American, the major costs are collection, transportation and disposal. It is estimated this amounts to from $3 billion to $8 billion a year.

It is unlikely that the exaggerations have balanced the understatements of these various estimates. Consequently combining the sums of the different construction projects and operating costs makes it doubtful that the uncertainties stressed above have been eliminated. Having gone this far however, we might just as well add them together to have a rough picture of how much they would all cost. The overall total of the different projects indicates that reducing environmental disruption could cost anywhere from about $50 billion to something approaching $100 billion. Annual operating costs would probably range from about $12 to $20 billion. These operating costs amount to approximately 1 to 2 percent of the annual GNP and 4 to 7 percent of the value of our industrial, agricultural, mining, and transportation output. Construction costs average about 3 to 7 percent for industry but may total more than 10 percent of the capital costs of some projects.

It is necessary to reemphasize that all such calculations are imprecise. Even if it is assumed that we know what standards we want to attain, it is still hard to project meaningful figures. Treatment technology is as yet relatively primitive. Technological breakthroughs could reduce costs significantly. Moreover, the estimates will be affected by what happens to population growth and concentration. If population increases, so will costs. It will also depend on what new industrial processes complicate existing treatment methods. Care must also be exercised in judging cost estimates because there is a tendency to overstate costs. Sometimes this is done by those who feel that the only way to obtain action is to create a crisis atmosphere. Regrettably, too often it takes a scandal or crisis before public support for meaningful programs can be obtained. At other times the costs are exaggerated for just the opposite reasons: to discourage pressure for change and also to win admiration for the expenditures already made. This is understandable, since almost everyone agrees that pollution control expenditures usually add nothing to profits. On the contrary, they generally result in diminished profits for industry (except for the producers of pollution control equipment) and in higher taxes.

Finally, it is difficult to determine how much man must do to clean up his water and air. Up to a certain point, water courses and air sheds have a natural self-cleaning power. This regenerative process has served admirably for the last several thousand years. It breaks down, however, when a threshold is passed and the amount of newly added dirty water and air suddenly overtaxes nature's cleansing capacity. The question that arises is how much should we expect nature to do on its own and how much should we require man to spend to facilitate the process? In some cases, man's help is a necessity; in other cases it is unnecessary. Deciding where nature's work ends and man's work begins is not easy.

One of the greatest challenges open to an economist today is to make a careful study of the effects of pollution. Unfortunately neither exaggeration nor understatement will ordinarily advance the long-run cause of those who seek reliable economic data. Until there are reliable estimates of damage, no appropriate value can be attributed to clean air and water. And, as long as the cost of clean air and water is undervalued, they will be used wastefully and irrationally.

Some critics have argued that the only long-run solution to environmental disruption is to call a halt to industrialization and economic growth. They argue that it is our fetish with growth that has caused such abuse to nature. To some extent they are right. Industrialization is like cooking an omelette. There is no way to avoid cracking eggs. Not only is this hard on the egg, but we then have the shells to dispose of. Yet it is unrealistic to expect that many people will agree to forego their expectations of increased comforts, much less give up existing comforts.

# Notes

[1] Robert E. Kohn, "Evaluating Air Quality Standards by Comparing Abatement and Damage Trade-offs Between Pollutants," mimeographed, paper presented at Winter Meeting of the Econometric Society, December 28, 1969; Robert J. Anderson, Jr. and Thomas D. Crocker, "Air Pollution and Residential Property Values," mimeographed, paper presented at Winter Meetings of the Econometric Society, December 28, 1969.

[2] Fred Singer, "Environmental Quality; When Does Growth Become Too Expensive?" mimeographed paper presented in the Symposium "Is There an Optimum Level of Population?" American Association for the Advancement of Science, Boston, Mass., December 1969, p. 13.

[3] *Ibid*.; Gene Bylinsky, "The Limited War on Water Pollution," *Fortune*, February 1970, pp. 104-5, 194.

[4] Federal Water Pollution Control Administration, U.S. Department of the Interior, *The Cost of Clean Water*, Summary Report, Vol. I (Washington, D.C.: Government Printing Office, March 1970), pp. 5-8.

[5] A system of holding tanks for the temporary storage of storm water overflows might obviate the need to construct separate sewers. This would cost a mere $15 billion. (See *Ibid*.; also *New York Times*, February 25, 1970, p. 59; Fortune, February *1970*, p. 195.)

[6] *New York Times*, March 17, 1970, pg. 29. CEQ *Environmental Quality*, *Second Annual Report* (Washington, D.C.: Government Printing Office, August 1971) pp. 111, 123. The CEQ's cost estimates for 1970-75 are slightly lower than ours would be if extended to 1975.

[7] Committee on Public Works, United States Senate, *On Pollution*, 1967. (Air Quality Act) S. 780, Part 3 (Washington, D.C.: Government Printing Office), p. 1361; *Fortune*, February 1970, p. 123; James J. Hanks and Harold D. Kube, "Industry Action to Combat Pollution," *Harvard Business Review*, September-October 1966, p. 57; The Working Committee on Economic Incentives, *Cost Sharing With Industry*? (Revised) (Washington, D.C.: Room 325, Executive Office Building, November 20, 1967), p. 21. CEQ Second Annual Report, p. 111.

# THE NATURE AND BEHAVIOR OF ECOLOGICAL SYSTEMS

C. S. Holling and M. A. Goldberg*

Rather than presenting an exhaustive treatment of ecological concepts and terms, we hope to apply the philosophy of the ecological approach to solve problems of a kind that recur in all complex systems.[1] The key insight of this approach is that ecological systems are not in a state of delicate balance. Long before man appeared on the scene, natural systems were subjected to traumas and shocks imposed by climatic changes and other geophysical processes. The ecological systems that have survived have been those that are able to absorb and adapt to these traumas. As a result, these systems have considerable internal resilience, but we know that this resilience is not infinite. A forest can be turned into a desert, as in the Middle East, or a lake into the aquatic analog of a desert. The key feature of the resilience of ecological systems is that incremental changes are absorbed. It is only when a series of incremental changes accumulate or a massive shock is imposed, that the resilience of the system is exceeded, generating dramatic and unexpected signals of change.

This has considerable consequence for planning, since, inherent in the philosophy of planning and intervention, is the presumption that an incremental change will quickly generate a signal of whether the intervention is correct or not. If the signal indicates the intervention produces higher costs than benefits, then a new policy and a new incremental change can be developed. But because of the resilience of ecological systems, incremental changes do not generate immediate signals of their effect. As a result, planners can set in motion a sequence of incremental steps and face the reality of the inadequacy of the underlying policy only when the interventions accumulate to shatter the bounds of resilience within the system. By that time it can be too late. In order to demonstrate these features of ecosystems we will discuss one specific case history, based on man's intervention. The consequences of the intervention reveal some of the key properties of ecosystems.

## Malarial Control in Borneo

Since the Second World War, the World Health Organization (WHO) has developed a remarkably successful malarial eradication program throughout the world. We wish to emphasize that, in this example of intervention, there is no question that there has been a dramatic improvement in the quality of life of people in affected regions. But, we wish to explore a specific case in which the World Health Organization sprayed village huts in Borneo with DDT in order to kill the mosquito that carries the plasmodium of malaria. This case has been documented by Harrison (1965).

The inland Dayak people of Borneo live in large single homes or long houses with up to 500 or more under one roof. This concentration of population allowed WHO to develop a thorough and orderly spraying of every long house, hut, and human habitation with DDT. The effect on health standards was dramatic with a remarkable improvement in the energy and vitality of the people-particularly those remote tribes who had not previously had access to medical aid. Nevertheless, there were interesting consequences that illuminate some of the properties of ecological systems.

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There is a small community of organisms that occupy the thatched huts of these villages--cats, cockroaches, and small lizards. The cockroaches picked up the DDT and were subsequently eaten by the lizards. In consuming the cockroaches, the lizards concentrated the DDT to a somewhat higher level than was present in the cockroaches. The cats ate the lizards and, by eating them, concentrated the level of DDT still further--to the point that it became lethal. The cats died. When the cats disappeared from the villages, woodland rats invaded, and it suddenly became apparent that the cats had been performing a hidden function--controlling rat populations. Now, with the rat came a new complex of organisms--fleas, lice, and parasites, and this community presented a new public health hazard of sylvatic plague. The problem became serious enough that finally the RAF was called to parachute living cats into these isolated villages in order to control the rats.

The story isn't finished at this point, however, since the DDT also killed the parasites and predators of a small caterpillar that normally causes minor damage to thatch roofs (Cheng 1963). The caterpillar populations, now uncontrolled, increased dramatically, causing the roofs of the huts to collapse.

We cite this example not because it has great substance, but simply because it shows the variety of interactive pathways that link parts of an ecological system, pathways that are sufficiently intricate and complicated so that manipulating one fragment causes a reverberation throughout the system. In addition, this case provides a simple example of a food chain in which energy and material moves from cockroaches to lizards to cats. Typically, in these food chains the number of organizms at a higher level in the chain are less abundant than those lower in the chain. This is the inevitable result of the loss of energy in moving from one trophic and nutritional level to another, and the consequence is a biological amplification that concentrates certain material at higher and higher levels as one moves up the chain. A contaminant like DDT, for example, can be present in the environment in very low, innocuous levels but can reach serious concentrations after two or three steps in the food chain. Actually, this example is highly simplified; usually in such situations there is a food *web* rather than a single linear food chain. Several species operate at more than one trophic level. Moreover, there are competitive interactions that further complicate and link species within an ecosystem. Even in this example, however, it is clear that the whole is not a simple sum of the parts and that there are a large number of components in a system acting and interacting in a variety of complex ways.

## Nature of Ecological Systems

This example illuminates four essential properties of ecological systems. By encompassing many components with complex feedback interactions between them, they exhibit a *systems* property. By responding not just to present events but to past ones as well, they show an *historical* quality. By responding to events at more than one point in space, they show a *spatial* interlocking property, and through the appearance of lags, thresholds, and limits they present distinctive *non-linear* structural properties. First, ecosystems are characterized not only by their parts but also by the interaction among these parts. It is because of the complexity of the interactions that it is so dangerous to take a fragmented view, to look at an isolated piece of the system. By concentrating on one fragment and trying to optimize the performance of that fragment, we find that the rest of the system responds in unsuspected ways.

Second, ecological systems have not been assembled out of preexisting parts like a machine: they have evolved in time and are defined in part by their history. This point does not emerge clearly from the example quoted; nevertheless, the resilience described in the example is very much the consequence of past history.

When a large area is stripped of vegetation, an historical process begins that leads to the evolution of a stable ecosystem through a series of successional stages. Early in this succession, pioneer species occupy the space, and the diversity and complexity are low. The species that can operate under these circumstances are highly resistant to extreme conditions of drought and temperature and are highly productive. Competition is low, and a large proportion of the incident solar energy is converted to the production of bio-mass (the standing stock of organic material). As this accumulates, the conditions of the area begin to improve and permit the appearance of groups of plants and animals that otherwise could not survive. The result is a gradual increase in the variety of species and in the complexity of interaction, and this increase in complexity is accompanied by an increase in the resilience of the system and a decrease in productivity. Under stable conditions this successional history can continue until a stable climax ecosystem evolves.

Man's objective in agricultural management is to halt this history at an early successional stage when the productivity is high. The price of doing this is a continual effort to prevent the system from moving to its more stable and less productive stage: hence herbicides and cultural practices eliminate or reduce those organisms that compete with man for food. But by emphasizing high productivity as a narrow objective, man develops the simplest and most direct policy, and the result leads to decreased complexity -- large monocultures, heavy use of chemical herbicides, insecticides, and fertilizers. For the short term, the narrow objective of increased productivity is achieved, but the price paid is a dramatic decline in the resilience of the system. Third, complex ecosystems have very significant spatial interactions. Just as they have been formed by events over time so they are affected by events over space. Ecosystems are not homogeneous structures but present a spatial mosaic of biological and physical characteristics.

Finally, there are a variety of structural properties of the processes that interrelate the components of an ecosystem. We do not wish to dwell on these details other than to say they present singular problems in mathematical analysis for they relate to the existence of thresholds, lags, limits, and discontinuities.

## Behavior of Ecosystems

The distinctive behavior of systems flows from these four properties. Together they produce both resilience and stability. Even simple systems have properties of stability. Consider the example discussed by Hardin (1963). Every warmblooded animal regulates its temperature. In man the temperature is close to 98.6°F. If through sickness or through dramatic change in external temperature, the body temperature begins to rise or fall, then negative feedback processes bring the temperature back to the equilibrium level. But we note this regulation occurs only within limits. If the body temperature is forced too high -- above 106°F., the excessive heat input defeats the regulation. The higher temperature increases metabolism which produces more heat, which produces higher temperature, and so on. The result is death. The same happens if temperature drops below a critical boundary. We see, therefore, even in this simple system, that stability relates not just to the equilibrium point but to the domain of temperatures over which true temperature regulation can occur. It is this domain of stability that is the measure of resilience.

In a more complex system, there are many quantities and qualities that change. Each species in an ecosystem and each qualitatively different individual within a species are distinct dimensions that can change over time. If we monitor the change in the quantity or quality of one of these dimensions, we can envisage results of the kind shown in Figure 1. Within the range of stable equilibrium, if we cause a change in the quantity being measured, it will return to equilibrium over time. But there is a limit to which we can perturb these quantities, and that limit is defined as a boundary of stability.

The domain of stability is contained within the upper and lower boundaries. In simple physiological and engineering control feedback systems, regulation is strong enough and conditions are stable enough that most of our attention can be fixed on or near the equilibrium. This is not true of ecological systems (Holling and Ewing 1969). Ecological systems exist in a highly variable physical environment so that the equilibrium point itself is continually shifting and changing over time. At any one moment, each dimension of the system is attempting to track the equilibrium point but rarely, if ever, is it achieved. Therefore, each species is drifting and shifting both in its quantity and quality. Because of this variability imposed upon ecological systems, the ones that have survived, the ones that have not exceeded the boundaries of stability, are those that have evolved tactics to keep the domain of stability, or resilience, broad enough to absorb the consequences of change. The regulation forces within the domain of stability tend to be weak until the system approaches the boundary. They are not efficient systems in an optimizing sense because the price paid for efficiency is a decreased resilience and a high probability of extinction.

This view of stability is, of course, highly simplified. There may not be just one stable equilibrium at any instantaneous point in time; there may be several. Moreover, the stable condition might not be a single value but a sequence of values that return to a common starting value. This stable condition is termed a stable limit cycle (Figure 2). Finally, the sequence of stable values need never return to some common starting point. The earlier description of an ecological succession really represents such a condition - a stable trajectory as illustrated in Figure 3.

But, however the equilibrium conditions change, they are all bounded, and what we must ask in judging any policy is not only how effectively an equilibrium is achieved, but also how the resilience, or the domain of stability, is changed. The two insecticide examples illustrate the point. The policies used in these cases were characterized by three conditions:

1. The problem is first isolated from the whole; that is, pests are damaging cotton.

2. The objective is defined narrowly; that is, kill the insect pest.

3. The simplest and most direct intervention is selected; that is broad-scale application of a highly toxic long-lived insecticide.

Each of these conditions assumes unlimited resilience in the system. By adopting these policies, the problem and the solution are made simple enough to be highly successful in the short term. So long as there is sufficient resilience to absorb the consequences of our ignorance, then the success can persist for a very long time. It is successful in the sense that the agriculturist can return his system almost instantly to an equilibrium point of one crop and no competing pests. The price paid, however, is the contraction of the boundaries of stability, and an equilibrium-centered point of view can be disastrous from a boundary oriented view.

It is this boundary oriented view of stability emerging from ecology that can serve as a conceptual framework for man's intervention into ecological systems. Such a framework changes the emphasis from maximizing the probability of success to minimizing the change of disaster. It shifts the concentration from the forces that lead to convergence on equilibrium, to the forces that lead to divergence from a boundary. It shifts our interest from increased efficiency to the need for resilience. Most important, it focuses attention on causes, not symptoms. There is now, for example, growing concern for pollution, but the causes are not just the explosion of population and consumption, but also the implosion of the boundaries of stability.

[1] The notion of incremental (or "marginal" in the economist's jargon) changes is part and parcel of cost-benefit analysis. Non-marginal investments, which can change the structure of prices and the allocation of resources, are difficult to deal with under present cost-benefit approaches. Thus, resilience is usually assumed by ignoring changes in prices induced by large-scale projects. See Prest and Turvey (1965) for a discussion of the assumptions concerning marginal and non-marginal projects.

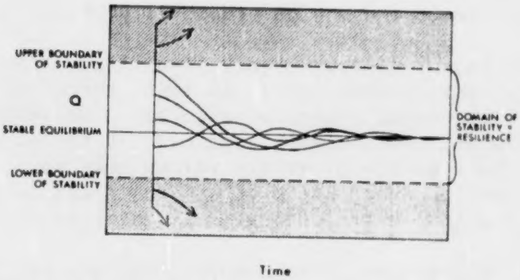
UPPER BOUNDARY OF STABILITY
Q
STABLE EQUILIBRIUM
LOWER BOUNDARY OF STABILITY
DOMAIN OF STABILITY = RESILIENCE
Time

FIGURE 1 *An Example of a System with a Stable Equilibrium in which Stability is Possible Within Distinct Boundaries*

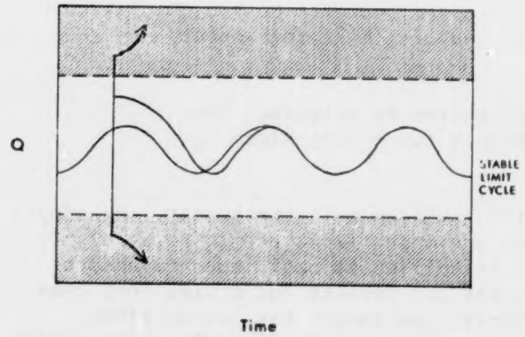

FIGURE 2 *An Example of a Bounded Limit Cycle*

HOLLING & GOLDBERG

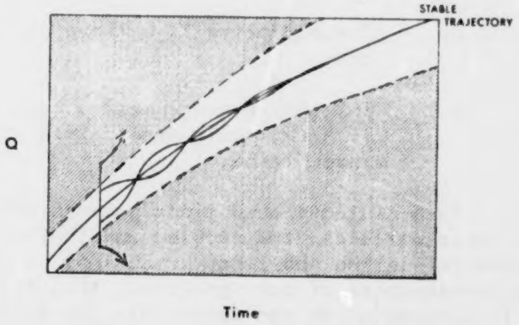

FIGURE 3 *An Example of a Bounded Stable Trajectory Analogous to that Found in an Ecological Succession*

# RESIDUALS AND ENVIRONMENTAL MANAGEMENT

Blair T. Bower*

Environmental resources have one feature in common; they are subject to *congestion*. In a low-density or economically undeveloped setting, an additional user of the natural environment may well impose essentially no cost on other users. As the density of development and the level of output increase, in the face of finite environmental resources, each additional user will impose additional costs associated with congestion on other users. This condition is termed an "externality" by economists--that is, the additional user does not take into account the costs he imposes on others in his decision to use a common property resource. Because there are no prices on the services rendered by the environmental media and since they cannot be exchanged between buyers and sellers in a market context, the usual mechanism in a market economy is not effective in limiting the use of environmental resources. This leads to excessive use of the natural environment, with resulting environmental "pollution," and the necessity for collective or public management.[1] The same failure to consider the finite assimilative capacity of the environment has resulted in overuse and environmental pollution in non-market economies as well.

One of the major problems for environmental management stems from the use of the environment for the disposition of residuals, the "leftovers" from production and so-called consumption activities. There are, of course, other aspects of the environment as a common property resource which do not involve residuals, but rather involve the *direct* effects of economic activities on the use of the environment. Examples are the impacts of the design and location of transmission lines, billboards, highways, and other transportation facilities on the aesthetic appearance of the landscape; modification or elimination of unique historical, scenic, and ecological resources by man's activities; and the direct impacts of mining and forestry activities on the visual qualities of the landscape and hence on other uses.[2] Only the residuals aspect of environmental management will be considered here.

## Residuals and Environmental Quality

Residuals, operationally defined, comprise--at a given point in time--the difference in weight and energy between the fuel, food, and raw material inputs to production and so-called consumption activities, and the outputs of those activities. Among the outputs are services such as heat and light; durable and nondurable consumer goods; the liquid, solid, and gaseous residuals which are not yet recycled into production; and energy residuals such as waste heat and noise.

Several "facts of life" with respect to residuals must be understood. First, the generation of residuals is pervasive; all human activities result in the generation of material and energy residuals. In fact there are no "consumption

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goods." So-called consumption goods eventually become residuals--junked cars, discarded furniture, demolition materials from urban redevelopment. Goods which have traditionally been labeled as being "consumed," in reality only render services temporarily. Their material substance remains in existence and must either be reused or eventually discharged into the environment, the only two methods of disposition possible. The law of conservation of mass cannot be denied.

An important corollary stems from this first fact of life. Prohibiting the discharge of all residuals into the environment--in effect placing an infinite value on "virgin" environmental quality--would make production of goods and services impossible, because no physical process is totally efficient.[3] Even in an economy in which total reuse were practiced, an economy which is simply impossible on a planetary scale, the energy requirements for physical recovery and reprocessing of residuals for reuse inevitably produce at least one unavoidable residual--heat.

The second fact of life is that there are physical, technologic, and economic interrelationships between the two major types of residuals--material and energy--and among the various forms of material residuals--gaseous, liquid, solid.[4] Efficient and equitable residuals-management cannot be achieved by dealing separately with individual residuals or individual environmental "media." Air quality management, water quality management, and solid residuals management should not be approached as separate activitites.

The third fact of life is that the incremental costs of removing additional quantities of residuals prior to discharge into the environment increase very rapidly as 100 percent removal is approached.[5] The cost of removing the last increment of a residual is substantially higher than the cost of removing the first increment. It must be remembered that the traditional so-called waste treatment processes merely modify the original forms of residuals. These processes themselves require inputs of material and energy and result in the generation of residuals. Essentially the objective of such processes is to modify the form of residuals to other material or energy residuals which presumably have less adverse impacts on environmental quality and on those exposed to the environment. Thus, it is clearly impossible to prevent completely the discharge of residuals.

The fourth fact of life is that all production and consumption activities utilize the assimilative capacity of the land, air, and water environments. While the services rendered by these environments are essential inputs into these activities, traditionally, no prices have been placed on these factor inputs. Hence, far more of them have been used than would be the case if the damages stemming from their use were properly taken into account through pricing. An optimal level of use would result under the proper pricing of environmental assimilative capacity.

## Residuals and Social Choices

Having described ...the role of the environment in providing residuals assimilation services, we can consider some of the salient issues and the societal choices they reflect.

First, the driving force of the residuals problem stems from the proliferation of goods and services "demanded" by an affluent society. The "throw away" philosophy has important implications for residuals-environmental quality management. Thus, to produce a specified set of goods and services, the total materials throughput necessary--and hence the quantity of residuals generated--decreases as the efficiency of utilization, including reuse, increases and the useful lifetime of goods increases. The longer machinery, cars, buildings, and other "durables" last, the fewer new materials are required to compensate for depreciation and/or to sustain a given rate of capital accumulation; consequently fewer residuals are generated in total. The same is true with respect to energy production--the more efficient combustion and energy generation processes are, the fewer residuals will be generated for a given energy output.

Second, there are many alternatives for handling residuals and for affecting environmental quality. These involve policy decisions relating to types of raw materials permitted for use in production processes, types of product outputs permitted, pricing policies relating to residuals discharges, location of economic activities in space, levels of environmental quality desired, distribution of costs of improving environmental quality, and specifications relating to methods for handling residuals (such as requiring specific levels of "waste treatment" rather than specifying a permitted quantity of discharge or establishing an effluent charge on each unit of residual discharge).

Third, environmental quality varies both in time and space, because of time variations in assimilative capacity of the various environmental media and in generation and discharge of residuals. Failure to consider the time and spatial variations of assimilative capacity can double, or more than double, the costs of achieving a desired level of quality.

Fourth, some types of residuals-environmental quality management policies can have significant economic impacts beyond the particular area or region in which the policies are applied to residuals dischargers. For example, it has been estimated that requiring the use of low sulfur coals to reduce sulfur dioxide discharges could result in the unemployment of 25,000 to 40,000 miners in Pennsylvania, Ohio, Illinois, and Indiana--at least in the short run.

Fifth, because environmental quality is comprised of a "mix" of elements, or environmental quality indices, and because not all the benefits corresponding to different levels of each index of environmental quality can be estimated, what is an optimal mix of environmental quality considering the range of residuals which affect the various environmental media and their users? Is a mix involving a reduction in liquid and gaseous residuals by 85 percent, lowering the intensity of background noise by 25 percent, and reducing the visibility and proximity of solid residuals by 50 percent better than, as good as, or not as good as a "mix" represented by reductions of 50 percent, 50 percent, and 25 percent, respectively--or any other combination?

Decisions and choices within the environmental sector are linked to decisions and choices in other sectors of the economy. Just as there are limited environmental resources, so there are limited human and capital resources. Environmental planning and management must explicitly recognize this allocation problem and seek to articulate the multiple trade-offs among societal values involved.

## Notes

[1] Manmade facilities, such as most roadways, bridges, and public recreation spaces, take on similar common property or collective good aspects, including congestion, as long as access to them is not controlled by property rights.

[2] These activities also typically result in the generation and discharge of residuals.

[3] It should be emphasized that the discharge of a residual into one or more of the environmental media does not inevitably result in a change in environmental quality. Nor do all changes in environmental quality have adverse effects.

[4] Water-borne, air-borne, and land deposited is another system of classifying residuals. Here again there are interrelationships. For example, some air-borne residuals are deposited on land and/or on water courses via "washout" from the atmosphere.

[5] For a discussion of this point, see, Kneese, A. V., and B. T. Bower. (1968) Managing Water Quality: Economics, Technology and Institutions (Baltimore: Johns Hopkins), pp. 44-62.

# PREFACE TO: II. PERSPECTIVES ON THE ENVIRONMENT

This section portrays three differing viewpoints on the environment. The environmentalist's point of view is presented by Dr. Barry Commoner; the economist's point of view by James Brian Quinn; the local officials' by Charles T. Henry.

Dr. Commoner in his article "The Environmental Cost of Economic Growth," examines the relationship of economic growth in terms of its potential environmental deterioration. He traces environmental deterioration through the post-war period--1946-1968--and concurrent technological development. Dr. Commoner notes various environmental impacts on the ecosystem resulting from human as well as industrial activity.

Quinn feels that pollution can be abated through the private enterprise system, which he documents in his article "Next Big Industry: Environmental Improvement." His economic analysis indicates that through the creation of new anti-pollution industries, the whole national economy would in turn be stimulated and the increased profits would ultimately pay the cost of environmental clean-up. The role of government is conceived as one of facilitating industry's clean-up. National performance standards are necessary to eliminate the present competitive disadvantage of pollution abatement. Temporary measures will be required to soften the blow certain industries may suffer due to changes in technologies. Overall, Quinn feels that private enterprise will be able to meet the new environmental challenge.

In "A Local Government Administrator's View of Environmental Management," Charles T. Henry is concerned with the environmental problems of a developed urban city, using the case study of University City to show how one community reacted to the environmental challenge. He examines the actual tools available to implement the environmental mandate. These tools often prove inadequate because of financial obstacles, interjurisdictional problems, legal inhibitions, and inadequate or expensive technology.

The variety of viewpoints illustrates the need for dialogue among different groups who are concerned with the environment: corporate officials, environmentalists, politicians, and government officials at all levels. The analyses of the causes and overall strategies must be translated into specific, achievable programs for specific localities. Only an integrated, high priority concerted effort is sufficient to meet the challenge ahead.

# A LOCAL GOVERNMENT ADMINISTRATOR'S VIEW OF "ENVIRONMENTAL MANAGEMENT"

Charles T. Henry*

Awareness or perceptions of community objectives, "critical environmental needs," and alternative strategies for improving the environment vary enormously among communities and their leaders. The leadership for ghetto residents might seek better employment opportunities, other family income sources, better schools, elimination of delapidated buildings, and improved housing, while the leadership for affluent communities want handsome public facilities, physically attractive neighborhoods, and elaborate housekeeping and leisure time services provided with maximum efficiency to their citizens. Both may seek safe and healthy environments.

The word, "environment," by referring to everything around us covers enormous territory. Discussions of "environmental management" often limit the subject to the physical environment, including air and water pollution, solid and liquid waste disposal systems, and resource recovery. Each of these are likely to be concerns of city managers and other local chief executives. Even while defining environment in the narrowest terms, one cannot ignore other interdependent features such as the economic health of communities and their capacity (people, legal, and financial resources) to combat environmental problems. Most, if not all of the daily concerns of city administrators relate to some broadly defined aspect of the urban environment, be it routine city services operations, utility operations, community development, people problem solving, or even funding policies.

## Local Administrators as Chief Environmental Officer

Generally, local administrators have tended to act as the guardians of their respective municipal environments and might be described as the chief environmental officers for their respective communities. Traditionally, they have sought to improve urban environments mainly by providing better public "housekeeping" and beautification services, by seeking better public facilities and by working for more effective regulation through municipal codes enforcement. At other times, however, they have given priority to improving their communities' economic environment either by supporting road building, more highrise buildings, or industry. This has been done perhaps to the long term detriment of the natural environment.

In general, local administrators tend to be pitted against special interest groups on behalf of the total community's interest. Other times, their efforts have been directed at citizen apathy or lack of understanding, and corresponding taxpayer resistance to pay for community betterment, as in the case of a bond issue for sewage facilities. Improving the environment, at the local level, depends on the difficult policy questions associated with determining who pays for what, when, how much, and for whose short or long term benefit. It is largely a matter of making the trade-offs vital to most political processes.

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*Charles T. Henry is City Manager, University City, Missouri. His article was prepared for this volume.

## Obstacles to Improving the Environment

Managing the urban environment might be defined as securing the best quality of life from the resources at hand. The local government administrator must contend with (1) financial obstacles; (2) interjurisdictional problems; (3) legal inhibitions, rooted in state and local law; and (4) inadequate technology. Often these obstacles may be a matter of economics and politics. For example, "inadequate technology" may actually mean that local decision-makers are unwilling to pay the current price for existing technology.

Although confronted by numerous obstacles, the local government administrator is faced with expanding opportunities and obligations to meet the environmental challenges. First, the ecology movement, in addition to focusing public attention on possible future world-wide disasters, has contributed greatly to making "John Q. Citizen" aware of his own community's environmental deficiencies. Although this heightened awareness may have complicated the lives of many local administrators, their struggles for a healthier, more attractive, and nuisance free urban environment have gained many new allies in the process. These range from "grandma eco freaks" to eager school children seeking environmental projects. Public agencies at all levels of government and private agencies in various types of business activity are putting forth more funding for environmental programs than ever before. In order to meet the added burdens precipitated by this new movement, local administrators must seek out new resources, new organizationl approaches, new procedures and programs. The remainder of this paper is addressed to such considerations.

## Organizing Local Government for a Better Environment

In true bureaucratic fashion (but with legitimate reasons) the initial response of many local administrators for meeting the environmental challenges may be a request for additional staff. Alternatives, such as creating new citizen committees or study commissions, are likely to lead to the same result with delays. Volunteer commissioners may give only so much of their time before they must request staff help. Moreover, many cities already have too many citizens' commissions dealing with overlapping environmental responsibilities such as beautification commissions, park and recreation commissions, sewer and water boards, public works boards, zoning boards, and planning commissions. Traditionally, the local administrator seeks to coordinate their activities through his staff which may be assigned to servicing these commissions. All too often he is refereeing their conflicts while trying to moderate their staff and resource demands.

University City, a St. Louis suburb of 50,000, some years ago created a permanent, advisory and coordinating staff position on environmental affairs. This person reports directly to the manager and is essentially a managerial assistant. Not the least of his duties has been that of first reviewing the avalanche of publications and reports on new environmental technology, new state and federal legal requirements, new environmental needs, and all of the management procedures and suggestions on these matters that come pouring every day into City Hall. Similarly he has to deal directly with newly formed local special interest groups and citizens who are concerned about environmental issues. Increasingly, he has become engaged in a considerable amount of environmental intergovernmental contact.

His most important assignment is to evaluate the broad spectrum of city operations and facilities that relate to the most pressing environmental needs. These assignments include; reviewing the quality and nature of city solid waste operations, the status of air pollution and noise pollution conditions; researching possible improvements in procedures and technology within the city's available resources; developing school recycling centers in cooperation with the children and school staffs; researching pesticide control ordinances; and devising a better record system for environmental sanitary inspectors. This position thus serves as the first screening and evaluation center for local government policy and implementation in environmental affairs.

In many cities, lack of funding and political infighting may require the local administrator to assume the duties of environmental management himself. This is particularly true in smaller communities. In other cities, he may assign environmental responsibilities to existing positions in the governmental structure. In larger jurisdictions, several positions may be performing environmental control functions within a single department, and several departments may be deeply involved in environmental matters. For example, an electrical services department of a major city has to be increasingly concerned with such matters as air and noise pollution control equipment at its own generating stations, as well as fuel content, waste disposal facilities and beautification of plant environs. The more environmental responsibilities are distributed among several departments and the larger the jurisdictions, the greater become the problems of coordinating major environmental strategies. Concurrently, the need to coordinate activities from a chief administrator's office also becomes greater.

## Environmental Code Development

The demands for a better urban environment tend to increase the volume and complexities of local, as well as state and federal, regulatory law. New environmental policy development in a municipality is expressed, in large measure, through revised city codes and ordinances. Apart from any federally imposed codes instigated under the old Workable Program requirements of the federal government, many municipalities recently have expanded and refined codes relating to the "environment" of private property. Control over "outside" environment is written into sanitation codes and in certain provisions of housing codes, both of which have procedures governing the removal and storage of solid and liquid wastes, derelict and unlicensed vehicles removal, control of weeds and high grass, dead trees removal, the paving and drainage of lots, overall control of litter on private property, and elimination or improvement of defective structures. Other controls have been introduced into zoning provisions, such as private landscaping controls, building size regulation, architectural design, sign controls, the undergrounding and placement of wiring, and various other attempts to minimize visual pollution. Community noise regulation in zoning and nuisance ordinances exist in relatively primitive forms. Many of these types of provisions are supplemented and reinforced through continual refinements in building code regulation for new construction of both residential and commercial buildings. Building maintenance codes, as distinct from building construction codes, are increasingly being enacted. More commonly known as housing codes, they are applied to both inside and outside elements of structure. Fire codes and heating and electrical equipment regulation codes for private buildings have grown in numbers and complexity in recent years.

Communities tend to adopt nationally recognized codes by references and utilize the experience of other jurisdictions as may be appropriate to their own situation. In some instances statewide codes requiring local enforcement have been enacted. City staffs, citizens' committees, and elected officials at the local level have borne the brunt of preparing most of this local government legislation. Managers often have difficult logistical problems in trying to supply the necessary information and the legal and technical resources, so that appropriate programs are formulated for adoption by city councils.

## Environmental Code Policy Implementation

Substantial administrative changes have become necessary as a result of the growing body of code regulation. These include increased staffing of specialist inspectors and legal assistants, as well as the development of specialized procedures and techniques such as elaborate record keeping systems. University City's sanitary inspectors routinely record litter violations by polaroid camera, and issue summonses which are processed through the record system, ultimately to the court. In a given year, about 1,500 litter notices are issued by a staff of 2 to 3 inspectors, and about 10 percent result in court appearances. This same group of inspectors will record about 600 weed violations a year, thereby initiating a process of notices, city weed cutting, and ultimate tax billing. They are supervised through a radio communications network. The Police Department, in another highly routinized process, annually serves notices on approximately 500 unlicensed vehicles on private property, quite apart from those on public streets. An adequate record system must back up this process so that the 10 percent uncooperative violators can be prosecuted in court and action taken, even after court prosecution. With respect to housing and commercial building maintenance, in 1967 this city adopted an occupancy permit approach whereby, on any change of occupancy, the building and premises are inspected. Residences are brought within reasonable compliance before new occupancy is permitted. About 1,000 buildings are so processed each year, and some 10,000 violations corrected. About 250 court cases support this effort. A well organized staff of housing inspectors and administrative personnel sustain this operation, along with the legal staff for court prosecutions. Some 29 cities in St. Louis County alone have adopted this occupancy permit approach to control neighborhood housing and, in effect, the neighborhood environment. To operate such complex programs with equity and efficiency, constant training and vigilant supervision of staffs, backed up with adequate records and controls, become imperative. Also needed is a cooperative court system and an overall base of community support.

## Legal Enforcement of Environmental Code Provisions

Federal and state agencies have been securing acceptance of greater environmental regulation through a number of techniques ranging from public reports to court injunctions imposed upon both public and private organizations. They have had additional carrots and clubs at their disposal by offering or withholding funding grants, while imposing a wide variety of conditions on local governments, ranging from the preparation of environmental impact statements to requiring construction of sewage plants. Although some cities may be in a position temporarily to withhold certain services, such as electricity, water or refuse collection, enforcement must rely on local court adjudication. Nothing may be more essential to securing local code compliance than an administrator's capacity to bring violations into a local court promptly (in a matter of two or three weeks). Failure to do so on a rather consistent basis jeopardizes pending and future enforcement actions. Capability thus means having an easily accessible municipal court or an equivalent county or state court which is available and familiar with these forms of law and willing to participate. Regrettably, such conditions seldom exist without considerable stimulation due to the newness of many of these regulatory activities.

In the St. Louis area the need gradually is being met with the creation of municipal housing courts, which might be better termed environmental courts, since they deal with local government regulatory law on matters well beyond housing maintenance. The role of these, as any municipal court, is to secure compliance and not simply to impose fines or penalties. Thus, various forms of leverage such as suspended and conditional penalties and escalating penalties for repeating offenders, may be appropriately imposed. Although litter and many sanitation violations might be considered routine and easily processed, zoning and housing code violations are relatively complicated. Thus, prosecution staffs and the court judges may develop effective processing only after considerable experience.

## Inter-departmental Committee for Environmental Affairs

As the multiplicity and complexity of environmental policing actions grew within University City, it was necessary to create a permanent inter-departmental staff committee. This need was dramatically illustrated by many earlier failures to achieve successful environments (housing) court actions. All the administrative staff needed training in matters of court procedures, and the prosecuting staff in matters and purposes of the codes.

This intergovernmental committee consists of representatives from almost all major city departments and department heads, including the Urban Renewal Director. Other regular attendees engaged in regulatory activities include high level supervisors from the police, fire, public works, housing, zoning, building and forestry departments, as well as other staff representatives whose clients may be affected by such regulatory actions, such as those of the Human Relations Department. The weekly meetings are chaired by the city manager or an assistant. The legal department is represented by the prosecuting attorney and/or an assistant. Each case which is to be brought to court is reviewed, and penalties are recommended or other negotiations suggested as means of securing compliance now and in the future. The prosecuting attorney then tries the case in the environmental court and presents the committee's recommendations to the judge. Frequently, many different departments and divisions simultaneously handle a single property or single family, thereby resulting in a useful exchange of knowledge. Since its inception, this inter-governmental committee's purposes have been broadened considerably to include discussions of various strategies, such as improvements in city services.

## Conclusion

The foregoing discussion focused on managing a predominantly developed urban environment. It represents a case study of selected actions for conserving existing urban neighborhoods, rather than providing an examination of managing expanding or high-growth environments. For example, in a high growth area, the environmental controls requiring most attention would be new subdivision regulations, the placement and nature of new public facilities, private and public land-use designs, and the community's overall comprehensive development plan. Plan Commissioners, planning staffs, and building and zoning inspectors would be among the leading local actors involved in these decisions. In contrast, neighborhoods already built would seek solutions to environmental problems by total obliteration and redevelopment.

The challenge facing local chief administrators begins with keeping abreast of the environmental movement and its ramifications so that they may assist councils and community leaders in decision making. The recent upsurge of environmental concerns certainly has forced local government officials to rearrange their priorities and the assignment of community resources.

# NEXT BIG INDUSTRY: ENVIRONMENTAL IMPROVEMENT

James Brian Quinn*

The often strident cries of the "environmentalists" have raised a fundamental challenge to the private enterprise system. Questions like these are basic concerns for all:

- Can a free society have both a high standard of individual wealth and a clean environment?
- Is the private enterprise system capable of providing those elements of "an improved quality of life" which represent public--rather than private--demands?
- Can industry meet environmental demands yet maintain its capacities to compete internationally?

I believe private enterprise can not only meet the challenge but thrive on it. To do so, however, requires some basic rethinking of the whole environmental issue. The following ideas are basic to this reconceptualization:

1. The demand for environmental improvement offers opportunities to nearly all types of companies to share in huge untapped primary markets.

2. Properly developed, these markets will create economic growth, which can pay for many of the environmental improvements sought.

3. Much of what appears to be "the national cost" of environmental improvement really represents new markets created by unfilled public demands.

4. Business and public policy should focus on: (a) developing these markets rationally, and (b) minimizing the real overhead costs of environmental improvement; i.e., unproductive bureaucracies, improperly established standards, unnecessary dislocations, and ineffective public expenditure systems.

5. It is not enough to approach environmental improvements as a "business responsibility." Fair and well-enforced national regulations, sensibly developed public-market mechanisms, and fiscal policies which support intended growth and investment patterns will be essential.

For purposes of this discussion, I use the term "environmental improvement" in its broad sense--to include not only such matters as cleaner water and air but

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also safer highways, healthier communities, and a better educated population.

## CREATING PUBLIC MARKETS

Our private enterprise system has developed the capacity to satisfy almost immediately the most detailed demands of any consumer, household unit, company, or institution in which a single authority can make purchasing decisions and has independent access to funds. But the system has been considerably less adept at developing and filling demands for public consumption and investment--hospitals, schools, water supplies, sewage systems, roads, parks, airports, waste disposal systems, and so on. If such public markets could be developed by private enterprise, however, they would provide exciting growth opportunities for many industries and simultaneously ameliorate many pressing social problems. For example:

- To clean up a river--and the shorelines and beaches it affects--requires sewage treatment plants, heat transfer units, cooling towers, waste and by-product processing units, improved storm drain and sewage systems, sophisticated monitoring apparatus, and so forth. These, in turn, create supplier markets for steel and metal products, construction equipment, pumps and treatment equipment, meters, switches, wire, electronic controls, construction materials, glass, ceramics, plastics, and chemicals in profusion.

This example suggests that demands for "a cleaner environment" or "a better quality of life" could create new or expanded markets for almost every industry--no matter how basic.

How do public markets come into being? They may be produced by (a) aggregating individual demands through public expenditures, and/or (b) forcing individual action through regulation or tax policy. Let us examine each of these forces in turn.

### Aggregating Demands

In some--but by no means all--cases, government bodies have to aggregate and dispense funds to purchase items individuals cannot afford. Refuse, sewage, transportation, education, recreation, and public safety systems would all fall in this category.

Can such expenditures result in net growth for society? Some traditional economists might argue that tax-financed public expenditures only transfer funds from one source to another--and consequently cannot provide net growth. But past experience does not support this view. For instance:

- In recent years publicly financed interstate highway systems and subsidized aircraft development have stimulated the growth of public travel, trucking, airlines, transportation fuels, and other related industries.

- The U. S. space program created a whole new market never previously conceived.

Environmental improvements could have a similar effect. Economic growth occurs whenever a society begins to commit energies and resources to fulfill "felt needs" beyond those it has been able to or willing to fulfill in the past. Almost all society's needs--beyond minimum food and shelter--are psychologically based. People need vacation homes and skis because they think they need vacation homes and skis. Similarly, as people begin to think they want an improved environment, this demand can be converted into a series of new markets. These markets merely require public--rather than private--action to aggregate and channel the resources needed to satisfy the demand.

Although the American consumer seems to have an extremely high capacity for absorbing ever more intricate trinkets, many consumer markets are approaching saturation--with growth essentially linked to population growth. By contrast, markets for improved public well-being seem remarkably unsaturated. Consumers are ready to spend much more in these areas. In addition, most forecasts show nondefense public expenditures increasing at a more rapid rate than private consumption. In fact, public markets probably offer the fastest growing primary markets of the next two decades. The real problem is to develop these markets so they contribute to national growth, and well-being and do not become endless "resource sinks" without significant social gain.

## Potential of Regulations

Properly administered, government regulations and standards can expand market opportunities. Obviously, the television and radio industry could not have developed without standardized signal patterns, regulated frequency allocations, and safety regulations for receivers. Individual companies had to change practices that initially appeared to be in their own self-interest, but they ultimately gained because their total markets expanded. Similarly, regulations of the Food and Drug Administration and the Department of Agriculture forced all companies to meet product quality and safety standards that some producers found objectionable. But such regulations helped create the consumer confidence that was essential to mass markets for most packaged foods, drugs, and household products.

Can this pattern also apply to currently proposed social and environmental regulations? I feel it can. Consider the following possibilities:

- When electric utilities install air and thermal depollution equipment, their rate bases need to be increased (to maintain their return on investment), thus allowing higher prices, dollar profits, and taxes. Power use for installed capacity is quite insensitive to small price changes, especially in the power-short East, where pollution is worst. Consequently, power companies, construction groups, and depollution equipment suppliers all gain (and pay increased taxes). And jobs are created in the area, with corresponding multiplier effects on all household and consumer items--including electric appliances.

- More stringent radioactive emission and waste disposal standards--which recent cases indicate nuclear producers can already meet--would increase confidence in atomic power plants and thus expand the market for them.

In short, the net effect of government regulation can be to express, through political processes, fragmented demands that individual consumers cannot effectively express in the market-place. Proper regulation can create new primary markets which contribute to national growth in the same way as a new product innovation. Just as television satisfied a latent demand for visual home entertainment, safety and depollution devices can fulfill latent demands for personal health and other intangible "qualities of life." Effective regulations simply aggregate these demands to a sufficient level to call forth the productive resources needed to satisfy them.

Needless to say, all government regulations affecting products and services do not create new market opportunities. They certainly do not if standards are developed, administered, or enforced in an illogical or haphazard manner. The point is that the potential often exists for regulation to increase total market opportunities, rather than to hinder or thwart real economic growth. But government and industry action is necessary to bring out this potential.

## COSTS VS. MARKETS

Clearly, improved environmental quality and public services are not free. What portion of proposed expenditures consists of self-supporting new markets? And what portion is really an increase in national overhead?

There is no question that each sewage treatment plant, air scrubber, or cooling tower represents a cost to its owners--as opposed to dumping waste into the environment. This is why so little action has been taken in the past. How, then, can depollution be anything but an added cost to society?

Environmental improvement can create self-sustaining domestic markets for better health care, housing, education, transportation or depollution systems. If people really want such benefits, they must be willing to pay for them just as they would pay for hair styling, mod clothes, or snowmobiles.

But can the values of growth more than offset the overhead costs of (a) collecting and dispensing needed funds and (b) regulating industrial practice when necessary? Assuming that our society has underemployed human and fiscal resources, each additional person employed in a new or expanded industry creates three or four new jobs in service and support industries, including retail and wholesale trades. If each of these people and their employers are paying taxes, it is not hard to see that the additional revenues from these groups alone could pay for the overhead costs of their industry--and, indeed, for a large portion of the new services themselves.

Add to this the employment and innovative effects of a generally higher demand level, and enough expansion could occur to exceed all of the costs of new public markets.

Under the specified conditions, the industries serving public markets become self-sustaining. Buyers pay the full cost of the benefits they receive, and the new industries do not become a drain on other sectors. It is plain fallacy to state that if people choose to spend part of their incomes on parks or health, this will somehow increase the cost structure for steel or chemicals. Even when the regulatory approach is used--for example, in depollution--buyers, not producers, ultimately pay the cost of services demanded. Producers actually have an opportunity to sell a product with greater value added; i.e., their product plus environmental improvement--just the kind of opportunity most are normally seeking.

The growth process just described is not immutable, of course. Two assumptions are vital: (a) the demands expressed through public purchases or pressures must be stronger than those substituted for; and (b) there must be some slack in the economy, i.e., some underemployment of people and capital. Otherwise the new

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industry would merely take away from one or more existing ones, and no real growth would result. But even when resources are limited, the public can increase the value (or utility) it receives--if it substitutes marginally important public purchases for less desired private consumption.

Note, that added capacity usually is available. There are unemployed people who want and are able to work. There are employees who, with training or better management, could become more productive. Investments could be made in new technologies that would free employees for work in other areas; and so on. So long as conditions like these are present, the environmental-improvement industry can add to GNP as other new industries have in the past.

## Sizing up the Costs

Actually the nation is already absorbing many costs that would be eliminated or reduced with environmental improvement. Polluted riverbeds and estuaries cause reductions of fishing, recreation, and housing-development potentialities that may be greater than depollution costs. Air pollution leads to physical plant depreciation, acidification of soil, cleaning bills, personal discomfort, and deteriorated health. And inadequate air traffic systems cost millions of dollars in personal delays and extra equipment operating costs, not to mention human life.

All of this is little comfort to the company, community, or individual who must suddenly pay the cost of a new depollution system. If a unit has capital, it could presumably devote its funds to purposes that yield more direct and shorter-term gains. However, many companies--including some prime producers of toxic effluents in the air--could pass depollution costs along, with little or no negative impact on profits. And many basic processing companies have found that they actually save money when forced to innovate in response to environmental controls. To illustrate:

° American Cyanamid Company is using new processes in Polk County, Florida that return ecologically harmful and unsightly phosphate strip mines to usable purposes, yet reduce costs by as much as one third.

° Dow Chemical Company recently reported that to date it has almost always found ways to lower costs when it improved effluent controls.

In many industries primary demand is relatively unchanged by small industrywide price changes--although similar price shifts by any one producer could cause a substantial shift in selective demand. In such cases, minor cost increases caused by depollution or safety regulations--applying to all producers--could be passed along in prices with a negligible impact on individual producers. Even in industries with higher depollution costs, demand shifts may be limited if there are no feasible substitute products or if functional competitors' costs increase by a similar amount.

Nevertheless, there will be some very real costs as society shifts its energies to environmental improvement. The following seem to be most important:

1. Lower growth in private demand for certain goods and services will undoubtedly occur in the short run.

2. Displacement costs can hit individual companies or communities hard. For example, marginal companies in small towns may lack the capital needed to meet new regulations.

3. Small price changes may seriously affect some industries' primary demand. This occurs when another product or service can be easily substituted for the one in use - for example, coal for oil in power plants. In these cases sizable industrywide displacements could result from increased investments or operating costs due to new standards. In time, this displacement would be absorbed by the growth in the industries with the substitute products or services.

4. Government bureaucracies could become an expensive result of environmental-improvement programs.

## Softening the Blow

The first three costs are merely characteristics of a market economy undergoing a demand change. If we really mean to have a market economy, the consequences of shifts to public demands should be accepted in the same vein as private consumption shifts. And the temporary distress these changes create can be relieved in familiar ways, such as stretching out the impact of the change, providing temporary tax relief, imposing short-term quotas, or helping communities injured by industry displacement. All of these have long been standard tools of public policy.

But, as soon as possible, such supports should be dropped so that each industry and company is competing on its won merits and absorbing its full costs. Society must ultimately pay--through higher prices, if necessary--for the added demands it places on producers. In a market economy the impact of these choices should be distributed through industry by the price mechanisms, with each company and industry absorbing the full cost of its existence.

International competition poses some special problems. For example, although the depollution industry could become self-sustaining on a domestic basis, individual producers' costs could increase vis-a-vis competitors in foreign countries with lower environmental standards. Foreign products shipped into the United States would, of course, be subject to U.S. product standards (e.g., automobile safety). But lower production costs--from more lax pollution standards--could allow equivalent foreign products to enter with a price advantage. And U.S.-made products would face similar price disadvantages in most overseas markets. The net impact on U.S. balances of trade and payments would undoubtedly be negative in the short run.

The problem is very real and should not be minimized. Still, it is mitigated by several factors. For one thing, a number of important U.S. companies overseas have production bases that can help them to relieve these cost disadvantages. For another, some of the industries most affected by environmental-improvement costs--for instance, electric utilities and basic process industries--are either not large exporters or are insulated from foreign competition by high transportation costs. Also, many important exports--like high technology products--should be relatively unaffected by environmental costs unless basic materials represent a high percentage of their cost. Finally, some U.S. antipollution devices and processes should become highly salable exports in themselves.

Another alleviating factor is that foreign countries too are becoming highly sensitive to ecological needs. Effluent charges have long been used along the Rhine river. Great Britain is now implementing a program for cleaning up the Thames and other rivers by means of better effluent control; Italy has drafted legislation that will control the pollution of its inland water systems through the construction of purification plants; and Sweden now requires new plants to incorporate the latest technology for pollution control. There are many other such examples.[1] Actions like these will certainly help equalize international competition.

Nevertheless, some U.S. industries will doubtless need temporary quotas, tax relief, or other protection. Multinational agreements on "off-sets" for relative pollution standards seem too difficult to achieve within the time span needed.

## RESTRUCTURING MARKETS

In this country, there has long been a demand for improved refuse, sewage treatment, transportation, medical, educational, housing, and recreational systems. More recently the public has demanded industrial water, air, effluent, and safety systems. However, these demands have not been converted into effective markets that producers can sensibly anticipate and serve. No one can now predict exactly how these markets can ultimately be best structured.

In many ways today's public market mechanisms are as undeveloped as consumer mass marketing was in the 1890's. But given a proper outlook, industry and government can together develop needed solutions--just as they evolved the social innovations that permitted mass private markets. Let us examine some of the main problems and most encouraging current trends.

### New Political Units

Precinct, town, county, and state units provide the electoral base for politicians and the funding base for taxation. But the boundaries of these units bear no relationship to today's public purchasing or regulatory problems. For example, water depollution may require consistent policies for a multistate river basin; air pollution abatement may require coordination on a broader regional basis; and so on. Our traditional political units complicate the processes of: (a) obtaining popular support for taxes needed on a regional level; (b) standardizing systems, components, and building specifications to achieve scale economies; (c) developing administrative units to oversee and/or manage regional expenditures; and (d) setting priorities among programs at a regional or national level.

But recently a new level of quasi-governmental "authorities" has evolved to coordinate action on specific functions or problems throughout the areas they affect. These authorities include river basin commissions, air quality agencies, regional transportation commissions, emergency service coordinators, port authorities, and so forth.

Although not completely effective now, these regional bodies may eventually provide a much needed decision mechanism for many new public markets. The big questions are whether they will be properly funded and whether they can force a reasonable degree of uniformity and coordination on local political units. If Congress uses these regional bodies to enforce national standards, and channels the bulk of its environmental funds through them, they could have enormous impact. Many county and state regulatory and purchasing functions could diminish in importance or disappear. And new mechanisms would be necessary for people to adequately express their preferences on priorities for the regional authorities themselves. This poses formidable problems.

### Improved Political Practices

Political decisions often seem to be keyed more to creating local headlines or maintaining power positions than to solving problems. Legislators frequently support this year's flashy ideas--the ones with high current visibility or emotional content--while prosaic tasks with a higher pay-off limp along. These fads often move too rapidly and inconsistently for industrial suppliers to risk development funds on them or to effectively plan other needed responses.

The problem is especially perplexing in new fields of government action like this one of environmental improvement. For a company to make the required long-term commitments, it needs some real assurance of long-term consistency in government regulations or fiscal support. Some answers to the latter may lie in trust funds, effluent fees, and fee-for-service pricing by public corporations. Although still experimental, such devices could provide relatively independent long-term financing for specific environmental improvements. Such funding, effectively administered through professional regional authorities, could eventually decentralize public-spending decisions to the degree needed to assure rational public markets.

Poorly formulated political standards have also been counterproductive. For example:

° Many informed observers feel that Congress' decision to move 1980 auto exhaust standards ahead to 1975 was made with inadequate recognition of some very serious technological problems faced by manufacturers. It may well be technically unfeasible to meet these standards without prohibitive price increases or solutions that markedly increase fuel consumption. Automotive company protests were ignored because Detroit had lost credibility during its earlier protests against pollution standards.

Actions like this erode the confidence of all parties and make rational progress difficult. Companies become defensive and will promise nothing in the fear that politicians will always demand more. Government agencies become frustrated by company intransigence and confused as to whether standards are real or merely strawmen. And the public becomes cynical as promised standards are never met or enforced.

Political factors will always enter regulatory and public expenditure decisions. But more thoughtful business leadership could (a) anticipate and avoid many crisis situations, and (b) actively stimulate programs that offer growth in markets and public well-being.

## Better Public Management

Ineffective administration and poor planning have often overwhelmed well-intended public programs. Early public housing programs are a case in point. Individual programs often destroyed more existing housing than they created. Currently the negative "second order consequences" of fertilizer, insecticide, "green revolution," superhighway, and welfare programs have been astonishing.

There is a great need to manage public expenditure programs better. Especially, new methods must be developed to measure the overall performance of regulatory and purchasing agencies and their subunits. Without such measures public administrators must follow costly, detailed contracting and internal control procedures that make it difficult to pinpoint responsibility and remove all efficiency incentives from contracts or operations. Of course, higher-caliber, professional and technical managers are essential to cope with planning, evaluation, and organizational problems at all agency levels. But entirely new institutional forms and management approaches are also needed to streamline regulatory and public purchasing agencies and to free them from undue political influence on their decisions.

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## WHAT CAN BUSINESS DO?

Now, what can business executives do--in their own self-interest--to help achieve the needed changes?

### Posture and Attitude

First, public markets and environmental controls must be approached as major strategic issues and not be relegated to back-bench decision makers. These issues pose some of the most critical opportunities and threats facing private enterprise in the next few decades. As such, they require companywide--if not industrywide--perspective and action. If companies do not respond to public demands effectively, the prerogatives of private enterprise can be swept away or drastically changed here as elsewhere. The threat is real. But so are the opportunities. As Henry Ford II said:

"The successful companies of the last third of the twentieth century will be the ones that look at changes in their environment as opportunities to get a jump on the competition. The successful companies will be those that anticipate what their customers, their dealers, their employees and their many other publics will want in the future, instead of giving them what they wanted in the past....These are the companies that will earn the highest profits for their stockholders by discharging their responsibilities to the society."[2]

Second, today's public demands cannot be dismissed as fads. They result from fundamental changes in population concentrations and affluence that will continue into the future. As one set of public problems is "solved," these and other forces will create new demands, which in turn will create new industries.

These new industries--to the extent that they add to production--will create some negative consequences. But, since their central purpose is to improve environmental quality, their net impact on the environment should be positive. However, in any complex system involving energy, manpower, and resources, there are likely to be some unpredictable consequences which may themselves create new challenges.

Any sensible scheme to satisfy them will leave essentially all production--and most technological--choices in private hands. But public groups must set the performance specifications and aggregate the resources to express public demands. To be effective their activities need aggressive business participation and support. Too often business groups--because of traditional thinking--have resisted legislation that could be in their own as well as the public's interest. To illustrate:

° Oil companies put up a powerful defense against the gasoline taxes that became the Highway Trust Fund. Yet this fund opened incredible growth opportunities for the industry.

Third, the notion of "business responsibility" alone will not solve current social problems. To gain short-term profits, some companies will always cut corners, struggle against safety or pollution regulations, and dogmatically resist public expenditures for health, education, or enviornmental quality. Some managements must lead the way--as many have in the past--to support social programs and to surpass all imposed environmental standards. Their leadership is absolutely essential to
(a) create the favorable political environment so necessary for all business,
(b) stimulate and restructure public markets to serve new public demands, and
(c) develop standards that are economic and effective throughout industry.

## Marketing and Credibility

Developing public markets requires a consistent, long-term program. At the outset the company must identify where its own best opportunities lie. For consumer product companies this may merely involve promoting their product and its safety or environmental benefits. Public utilities may sell both their direct services and cleaner air or a less cluttered skyline. Other companies may need careful input/output or other analyses to see how larger public markets could benefit their particular operations, so that each can then select the few significant public opportunities it can most sensibly influence.

The next step may be to stimulate a deeper public awareness of what could be done. Depending on the status of public and political perceptions, fairly low levels of advertising and public relations may be adequate at this stage. The power of such efforts in the public sector seems generally underestimated.

The average person now spends more time in contact with TV and other media than in any other waking activity expect his job. And these media are prime creators of personal values. If even a small percentage of media messages emphasize public needs, people could be vastly influenced. No single company has to dilute its product message appreciably, provided that others in the industry are working in the same direction. Interestingly, last year's enormous dissemination of environmental concern was probably achieved more by sponsored TV programs--news and otherwise--than by any other single force. The same power can be used to stimulate other public demands.

Once these demands begin to crystallize, more direct political action is possible. Responsible politicians have more latitude for action. And, if a company or industry has built up its public credibility and has a thoroughly thought-out position on key features of needed legislation, it can effectively lobby or participate in decisions covering public markets or regulation.

Such a program would have eased the problems of the automobile industry. Despite the substantial technical work the industry had done on environmental questions, the companies did not adjust automobile designs to mitigate growing public disenchantment with air pollution and accident costs. As political pressures built up for regulation, managements became increasingly defensive and emphasized the difficulty or impossibility of improved performance. Their intransigence gave their opponents added opportunities for attack. Public impatience increased. The industry lost credibility. And political activists forced more stringent regulations than would have been necessary.

## Setting Standards

In the environmental sphere, development and enforcement of effective standards are the keys to progress. What specific approaches should industry support in its--and the public's--interest?

1. Nationwide standards uniformly enforced are essential. Otherwise, some local groups may lower standards or not have the political will or power to enforce them. Such situations create competitive inequities that reward those who act most irresponsibly. National standards also help build aggregate demand for depollution devices and systems, enabling some suppliers to achieve economies of scale, lower depollution costs, and create the jobs, tax revenues, and growth that could help pay for environmental improvement.

2. Standards should be set well in advance. Except in emergency cases like severe mercury contamination, standards should normally be announced at least three to five years before their effective date, and broad guidelines should be projected for a decade ahead. Only then can company and town managers minimize total costs by efficient planning of utility and plant locations, process changes, product designs, fund raising, and capital commitments.

3. Performance specifications should be used whenever possible. Material, practice, or product specifications freeze design and innovation. But functional or performance specifications can express the results desired. Managers can then choose the lowest cost method for achieving these results, given the particular resources and processes available. Performance standards also encourage the research, innovation, and competition that can minimize total safety and depollution costs for society.

4. Federal fiscal policies should be pointed toward the maintenance of total economic growth during the changeover period to help absorb displacements and short-term profit drains. Such measures combined with carefully phased introduction of regulations could allow many industries' overall growth rates to more than offset substitution losses from minor differences in depollution costs among functionally competitive industries.

5. Healthy regulatory agencies are essential for equity and progress in environmental control. But they must be kept to minimum sizes, be exceedingly well staffed, and be open to public scrutiny and policy review. Each major environmental agency should have the support of a competent technical laboratory system.

Legislation establishing regulatory agencies should define the physical goals to be accomplished along with fixed dates for achievement. And performance against these targets should be monitored, at least annually, through public reports. The entire mission of each agency should be reviewed and explicitly revised every five years to recognize the fact that environmental needs will constantly change.

## CONCLUSION

Needed practices and institutional changes will only come about if an influential segment of industry acts vigorously and consistently in its long-term self-interest. The essential actions must come from the very top of the organization. If taken in time, such actions can be effective.

Top executives may have to make some critical changes in marketing attitudes and management controls to give public-market programs needed momentum. New-product efforts toward environmental improvement may need special long-term recognition and support at the corporate level--such as Carborundum and other companies have already begun to give them. And current profit and return-on-investment standards in operating divisions may need adjusting to allow the long-term investments in research, marketing, public relations, lobbying, and public action programs that help build their public markets. Further action may be needed to insure that middle managers do not cut regulatory corners to increase short-term profits. Companies seeking to build public markets will have to accept--and even encourage--environmental control over their own operations.

The public will not clean up dumps and sewage spills unless industries control their effluents. And both water and air depollution campaigns are integrally intertwined with other demands for better overall health care and recreational opportunities. These cannot be separated from transportation, open space, and housing demands, which in turn relate to traffic control, urban development, and other public-service commitments, including education. In short, these huge markets interlock and grow together--and whether they grow to become opportunities or threats depends on how industry responds to them.

Every new public demand for environmental improvement represents an unexploited primary market. Companies must take positive action to convert these demands into viable opportunities. Properly developed, such markets can be financed from the economic growth they permit; they need not create massive social overheads, as so many people assume. But improperly developed, they can become tax sinks, regulatory nightmares, and bureaucratic potholes that sap the resources of our whole society. The choice is largely up to business leadership.

## NOTES

[1] See Theodore Swanson, "Europe Cleans House," The Lamp, Spring 1971, p. 38.

[2] The Human Environment and Business (New York, Weybright and Talley, Inc., 1970), p. 63.

# THE ENVIRONMENTAL COST OF ECONOMIC GROWTH

Barry Commoner*

The environment is defined as a system comprising the earth's living things and the thin global skin of air, water and soil which is their habitat.

This system, the ecosphere, is the product of the joint, interdigitated evolution of living things and of the physical and chemical constituents of the earth's surface. On the time scale of human life the evolutionary development of the ecosphere has been very slow and irreversible. Hence the ecosphere is irreplaceable; if the system should be destroyed, it could never be reconstituted or replaced either by natural processes or by human effort.

The basic functional element of the ecosphere is the ecological cycle, in which each separate element influences the behaviour of the rest of the cycle, and is in turn itself influenced by it. For example, in surface waters fish excrete organic waste, which is converted by bacteria to inorganic products; in turn, the latter are nutrients for algal growth, the algae are eaten by the fish, and the cycle is complete. Such a cyclical process accomplishes the self-purification of the environmental system, in that wastes produced in one step in the cycle become the necessary raw materials for the next step. Such cycles are cybernetically self-governed, dynamically maintaining a steady state condition of indefinite duration. However if sufficiently stressed by an external agency, such a cycle may exceed the limits of its self-governing processes and eventually collapse. Thus, if the water cycle is overloaded with organic animal waste, the amount of oxygen needed to support waste decomposition by the bacteria of decay may be greater than the oxygen available in the water. The oxygen level is then reduced to zero; lacking the necessary oxygen, the bacteria die and this phase of the cycle stops, halting the cycle as a whole. Evidently, there is an inherent limit to the turnover rate of local ecosystems and of the global ecosystem as a whole.

Human beings are dependent on the ecosphere not only for their biological requirements--oxygen, water, food--but also for resources which are essential to all their productive activities. These resources, together with underground minerals, are the irreplaceable and essential foundation of all human activities.

If we regard economic processes as the means which govern the disposition and use of resources available to human society, then the continued availablity of those resources which are derived from the ecosphere, i.e., non-mineral resources and therefore the stability of the ecosystem, is an essential prerequisite for the success of any economic system. More bluntly, any economic system which hopes to survive must be compatible with the continued operation of the ecosystem.

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Due to lack of space and time, all tables, figures, and footnotes have been eliminated and can be found in the original sources.

Because of the turnover rate of an ecosystem is inherently limited, there is a corresponding limit to the rate of production of any of its constituents. Different segments of the global ecosystem--e.g., soil, fresh water, marine ecosystems--operate at different intrinsic turnover rates and therefore differ in the limits of their productivity. On purely theoretical grounds it is self-evident that any economic system which is impelled, by its own requirements for stability, to grow by constantly increasing the rate at which it extracts wealth from the ecosystem must eventually drive the ecosystem to a state of collapse. Computation of the rate limits of the global ecosystem or of any major part of it are, as yet, in a rather primitive state. Apart from the foregoing theoretical and as yet unspecified limit to economic growth, such a limit may arise much more rapidly if the growth of the economic system is dependent on productive activities which are especially destructive of the stability of the ecosystem.

Unlike all other forms of life, human beings are capable of exerting environmental effects which extend, both quantitatively and qualitatively, far beyond their influence as biological organisms. Human activities have also introduced into the environment not only intense stresses due to natural agents (such as bodily wastes), but also wholly new substances not encountered in natural environmental processes--artificial radioisotopes, detergents, pesticides, plastics, a variety of toxic metals and gases, and a host of man-made, synthetic substances. These human intrusions on the natural environment have thrown major segments of the ecosystem out of balance. Environmental pollution is the symptom of the resultant breakdown of the environmental cycles.

THE PROBLEM. In order to evaluate the cost of economic growth in terms of the resultant environmental deterioration, it is, of course, necessary to define both terms, if possible, in quantitative dimensions that might permit a description of their relationship. The common definition of economic growth would appear to be applicable here--the increase in the goods generated by economic activity. Environmental deterioration is a more elusive concept. On the basis of the foregoing discussion it may be defined as degradative changes in the ecosystems which are the habitat of all life on the planet. The problem is to describe such ecological changes in terms that can be related, quantitatively if possible, to the processes of economic growth--that is, to increased production of economic goods.

To begin with we can take note of the self-governing nature of the ecosystem. It is this property which ensures its stability and continued activity. This basic property helps to define both the process of ecological degradation and the nature of the agencies that can induce it. We can define ecological, or environmental, degradation as a process which stresses an ecosystem so that it reduces its capability for self-adjustment, and which, therefore, if continued can impose an irreversible stress on the system and cause it to collapse.

An agency which is capable of exerting such an effect on an ecosystem must arise from outside that system. This results from the cyclical nature of the ecosystem, which brings about, automatically, the system's readjustment to any internal change in the number or activity of any of its normal biological constituents. For what characterizes the bahaviour of a constituent which is part of an ecological cycle is that it both influences and is influenced by the remainder of the cycle. For example, organic waste produced by fish is a closed aquatic ecosystem, such as a balanced aquarium, cannot degrade the system because the waste is converted to algal nutrients, and simply moves through the ecological cycle back to fish. In contrast, if organic waste intrudes upon this same ecosystem from without, it is certain to speed up the cycle's turnover rate, and if sufficiently intense, to consume all the available oxygen, and bring the cycle to a halt.

The internal changes in an ecosystem which occur in response to an external stress are complex, non-linear processes and not readily reduced to simple quantitative indices. The aquatic ecosystem is one of the relatively few instances in which this goal can, to some degree, be approached--in that oxygen tension is a sensitive internal indicator of the system's approach to instability. However, in most cases such internal measures of the state of an ecosystem have not yet been elucidated. Hence, as a practical, but, it is to be hoped, temporary expedient we need to fall back on a measure of the impact on the ecosystem of an external degradative agency as an index of environmental quality. This expedient has the virtue of enabling the quantitative comparison of the effects of ecological impacts of different origins, a matter of particular importance in connection with their relation to economic processes. Later, when the necessary ecological information becomes available, such data can be translated to the resultant internal changes.

Thus, in this article, the enviornmental cost of a given economic process will be represented by its enviornmental impact, a term which has the dimensions of the amount of an agency external to the ecosystem which, by intruding upon it, tends to degrade the system's capacity for self-adjustment.

Turning to the possible environmental impacts that may result from human activity, we find the situation somewhat complicated by the special role of human beings on the earth. In one sense, human beings are simply another animal in the earth's ecosystem, consuming oxygen and organic foodstuff and producing carbon dioxide, organic wastes, heat and more people. In this role, the human being is a constituent part of an ecosystem and therefore in terms of the previous definition exerts no environmental impact on it. However, a human population has a zero environmental impact only as long as it is in fact part of an ecosystem, which is the case, for example, if food is acquired from soil which receives the population's organic waste. If a population is separated from this cycle, for example, by settling in a city, their wastes are intruded, with or without treatment, into surface waters. Now the population is no longer a part of the soil ecosystem and the wastes become external to the aquatic system on which they intrude. An environmental impact in generated, leading to water pollution.

On the basis of these considerations, people--viewed simply as biological organisms--generate an environmental impact only in so far as they become separated from the ecosystem to which, in nature, terrestrial animals belong, as is, or course, nearly universally true in the United States. The intensity of this environmental impact is generally proportional to the population size.

All other environmental impacts are generated, not by human biological activities, but by human productive activities, and are therefore governed by economic processes. Such impacts may be generated in several different ways. First, certain economic gains can be derived from an ecosystem by exploiting its biological productivity. In these cases, a constituent of the ecosystem which has economic value--for example, an agricultural crop, timber or fish--is withdrawn from the ecosystem. In so far as the withdrawn substance or a suitable substitute fails to return as nutrient to the ecosystem from which it was removed it constitutes a drain on that system which cannot continue indefinitely without causing it to collapse. Examples of such effects are the destructive erosion of the soil following excessive exploitation, and the incipient destruction of the whaling industry due to the extinction of whales.

Environmental stress may also arise from an intrusion of opposite sign--that is the amount of some component of the ecosystem is augmented from outside that system. This may be done either for the purpose of disposing of waste or in order to accelerate the system's rate of turnover and thus increase its yield. Examples of these effects are the intrusion of sewage into surface water, and the intensive use of fertilizer nitrogen in agriculture. In the latter case, following a reduction in the nitrogen available from the soil's natural store of nutrient (its organic humus) due to a period of over-exploitation through uncompensated crop withdrawal, i.e., a stress of the type descriped above, the nitrate level is artificially raised by adding fertilizer to the soil's ecological cycle. Because of the low efficiency of nutrient uptake by the crop's roots, which is in turn a result of inadequate soil oxygen due to reduced porosity stemming from the decreased humus content, a considerable portion of the fertilizer leaches from the soil into surface waters--where it becomes an external stress on the aquatic ecosystem, causing algal overgrowths and the resulting breakdown of the self-purifying aquatic cycle.

Apart from the above stresses--which represent the impact of externally altered concentrations of natural ecosystem constituents--environmental impact may be due to the intrusion into an ecosystem of a substance wholly foreign to it. Thus DDT has a powerful environmental impact in part because it readily upsets the naturally balanced ecological relations among insect pests, the plants they attack, and the insects which, in turn, prey on the pests. DDT-induced outbreaks on insect pests often result. In general, there is a considerable risk of environmental pollution whenever productive activity introduces substances which are foreign to the natural environment.

We turn now to the practical problem of evaluating the environmental cost of economic growth. The most general theoretical aspect of this problem has already been alluded to. Given that the global ecosystem is closed, and that its integrity is essential to the continued operation of any conceivable economic system, there must be an upper limit to the growth of productive activities on the earth.

However, such a theoretical statement is hardly an effective guide to practice. The chief reason is that the theory fails to specify the time scale in which the ecological limitation on economic growth is likely to take effect. For one can readily grant the truth of such an abstarct theorem--for example, that economic growth will eventually be limited by the extinction of the sun--and disregard its practical consequences because of the rather long time scale involved, in this case some billions of years.

Accordingly it would seem useful to make the problem more concrete by examining the relationship between economic growth and environmental impact in the real world. And since growth is, of course, a time-dependent process, this suggests the value of an historical approach.

ORIGINS OF ENVIRONMENTAL IMPACTS. The American Association for the Advancement of Science committee on environmental alterations, in collaboration with Corr and Stamler, has attempted to describe the origins of environmental impacts in the United States.[1] The results of their initial efforts are described here. Most U.S. pollution problems are of relatively recent origin. The post-war period, 1945-46, is a convenient benchmark, for a number of pollutants--man-made radioisotopes, detergents, plastics, synthetic pesticides and herbicides--are due to the emergence, after the war, of new productive technologies. The statistical data available for this period in the U.S. provide a useful opportunity to compare the changes in the levels of various pollutants with the concurrent activities of the U.S. productive system that might be related to their enviornmental effects.

Although we lack sufficient comprehensive data on the actual environmental levels of most pollutants, some estimates of historical changes can be made from intermittent observations, and from computed data on emissions of pollutants from their sources. Some of the available data are summarized in Table 1, which indicates that since 1946, emissions of pollutants have increased by 200-2000 per cent. For phosphate, which is a pollutant of surface waters, and enters mainly from municipal sewage, data on the long term trends are available; these are shown in Fig. 1.[2] In the 30-year period between 1910 and 1940, phosphorus output from municipal sewage increased gradually from about 17 Mlb $a^{-1}$ to about 40 Mlb $a^{-1}$. Thereafter the rate of output rose radidly; so that in the 30-year period 1940-70 phosphorus output increased to about 300 Mlb $a^{-1}$.

It should be noted that these are data regarding the computed emission of pollutants, which are not necessarily descriptive of their actual concentrations in the environment or of their ultimate effects on the ecosystems or on human health. Numerous, complex and interrelated processes intervene between the entry of a pollutant into the ecosystem and the expression of its biological effect. Moreover, two or more pollutants may interact synergistically to intensify the separate effects. Most of these processes are still too poorly understood to enable us to convert the amount of a pollutant entering an ecosystem to a quantitative estimate of its degradative effects. Nevertheless it is self-evident that these effects have increased sharply, along with the rapid rise of pollutant levels, since 1946. Since pollutant emission is a direct measure of the activity of the source, it is a useful way to estimate the contributions of different sources to the overall degradation of the environment.

If we define the amount of a given pollutant introduced annually into the environment as the environmental impact (I), we can relate this value to the effects of three major factors that might influence it by the following identity:

$$I = \text{Population} \times \frac{\text{Economic good}}{\text{Population}} \times \frac{\text{Pollutant}}{\text{Economic good}}$$

Population refers to the size of the U.S. population in a given year, economic good refers to the amount of a designated good produced (or where appropriate, consumed) during the given year, and pollutant refers to the amount of a specific pollutant (defined as above) released into the environment as a result of the production or consumption of the designated good, during the given year. This relationship enables us to estimate the contribution of three factors to the total environmental impact: (a) the size of the population; (b) production or consumption *per capita*, i.e. 'affluence;' (c) the environmental impact, i.e. amount of pollutant, generated per unit of production or consumption, which reflects the nature of the productive technology.

Since we are concerned with identifying the sources of the sharp increases in the environmental impacts experienced since 1946, it is of interest to examine the concurrent changes in the nation's productive activities. The most general data relevant to these changes are presented in *Fig. 2*. In the period 1946-48 U.S. population increased at an approximately constant rate by about 42 per cent; GNP (adjusted to 1958 dollars) increased exponentially by about 126 per cent; GNP *per capita* also increased approximately exponentially by about 59 per cent.

We can see at once that, as a first approximation, the contribution of population growth to the overall values of the environmental impacts generated since 1946 is of the order of 40 per cent. In most cases, this represents a relatively small contribution to the total environmental impact, since as indicated in Table 1, these values increased by 200-2000 per cent during the period.

In order to evaluate the effects of the remaining factors it is useful to examine the growth rates of different sectors of the productive economy. For this purpose, a series of productive activities which are likely to contribute significantly to environmental impact and are representative of the overall pattern of the economy have been selected. From the annual production (or where appropriate, consumption) data for the U.S. as a whole, the annual percentage rates of increase or decrease have been calculated. The results of these computations are presented in *Fig. 3*, from which it is possible to derive certain useful generalizations about the pattern of U.S. economic growth. Productive activities fall into three main groups.

First, production and consumption of certain goods have increased at an annual rate about equal to the annual rate of increase of the population, so that *per capita* production remains essentially unchanged. This group includes food, fabric, and clothing, major household appliances and certain basic metals and building materials, including steel and copper, and brick. In effect, for these basic life necessities, average affluence has remained essentially unchanged.

Secondly, the annual production of certain goods has decreased since 1946, or has increased at an annual rate below that of the population. Horsepower produced by work animals is the extreme case; it declined at an annual rate of about 10 per cent. Other items in this category are saponifiable fat, cotton fibre, wool fibre, lumber, milk, railroad horsepower, and railroad freight. These are goods which have been significantly displaced in the pattern of production during the course of the overall growth of the economy. Cultivated farm acreage also declined.

Thirdly, there are the productive activities which have increased at an annual rate in excess of that exhibited by the population. Certain of the rapidly increasing productive activities are substitutes for activities that have declined in rate, relative to the population. These generally represent technological displacement of an older process by a newer one, with the sum of goods produced remaining essentially constant, *per capita*, or increasing. These displacement processes include: natural fibres (cotton and wool) by synthetic fibres; lumber by plastics; soap by detergents; steel by aluminium and cement; railroad freight by truck freight; harvested acreage by fertilizer; returnable by non-returnable bottles.

Others of the rapidly growing productive activities evident in *Fig. 3* are secondary consequences of displacement processes. Thus the displacement of natural products by synthetic ones involves the use of increased amounts of synthetic organic chemicals, so this category has increased sharply. Moreover, since many organic syntheses require chlorine as a reagent, the rate of chlorine production has also increased rapidly. And because chlorine is efficiently produced in a mercury electrolytic cell, the use of mercury for this purpose has increased at a very considerable rate. Similarly, the rapidly rising rate or power utilizatin is, in part, a secondary consequence of certain displacement processes, for a number of new technologies are more power-consumptive than the technologies which they replace.

There is a third group discernible among the rapidly growing productive activities (Fig. 3). These are neither displacements of older technologies, nor sequelae to such displacements, but true increments in per capita availability of goods. An example of this category is consumer electronics--radios, television sets, sound equipment etc. Such items represent true increases in affluence.

IMPACT OF ECONOMIC GROWTH. Given the foregoing conclusions, we can now rephrase the original question as: What are the relative costs, in intensity of environmental impact, of the several distinctive features of the growth of the U.S. economy from 1946 to the present? Reasonably complete quantitative answers to this question are well beyond the present state of knowledge. In most cases it is possible to provide only an informal, qualitative, description of the changes in environmental impact which have been induced by the post-war transformation of the economy; although some quantitative evaluations in the form of environmental impact indices and a few partial environmental impact inventories can be constructed. As shown below, such evidence leads to the general conclusion that in most of the technological displacements which have accompanied the growth of the U.S. economy, the new technology has an appreciably greater environmental impact than the technology which it has displaced, and that the post-war technological transformation of productive activities is the chief reason for the environmental crisis that we have at present.

Agricultural production. Agricultural production, as measured by the U.S. Department of Agriculture crop index, has increased at about the same rate as the population since 1946 (Fig. 3). However, the technological methods for achieving agricultural production have changed significantly in that period. One important change is illustrated by Fig. 4, which shows that although agricultural production per capita has incraased only slightly, harvested acreage has decreased, and the use of inorganic nitrogen fertilizer has risen sharply. This displacement process of fertilizer for land leads to a considerably increased environmental impact.

The relevant ecological situation is as follows.[3] Nitrogen, an essential constituent of all living things, is available to plants in nature from organic nitrogen, stored in the soil in the form of humus. Humus is broken down by bacteria to release inorganic forms of nitrogen, eventually as nitrate. The latter is taken up by the plant roots and reconverted to organic matter, such as the plant's protein. Finally the plant may be eaten by a grazing animal, which returns the nitrogen not retained in the growth of its own body to the soil as bodily wastes.

Agriculture imposes a negative drain on this cycle; nitrogen is removed from the system in the form of the plant crop or of the livestock produced from it. In ecologically sound husbandry, all the organic nitrogen produced by the soil system other than the food itself--that is, plant residues, manure, grabage--is returned to the soil, where it is converted by complex microbial processes to humus and thus helps to restore the soil's organic nitrogen content. The deficit, if it is not too large, can be made up by the process of nitrogen fixation in which bacteria, usually in close association with the roots of certain plants, take up nitrogen gas from the air and convert it into organic form. If the nitrogen cycle is not in balance, agriculture 'mines' the soil nitrogen, progressively depleting it. This process does more than reduce the store of organic nitrogen available to support plant growth, for humus is not only a nutrient store. Due to its polymeric structure humus is also responsible for the porosity of the soil to air. And air is essential to the soil, not only as a source of nitrogen for fixation, but also because its oxygen is essential to the root's metabolic activity, which in turn is the driving force for the absorption of nutrients by the roots. In the U.S., for example in Corn Belt soils, about a half of the original soil organic nitrogen has been lost since 1880. Naturally, other things being equal, such soil is relatively infertile and produces relatively poor crop yields. However, begining after World War 2, a technological solution was intensively applied to the soil in the form of fertilizer. Annual nitrogen fertilizer usage in the U.S. increased by an order of magnitude during the period 1946-68.

In effect, nitrogen fertilizer can be regarded as a substitute for land. With the intensive use of fertilizer it is possible to accelerate the turnover rate of the soil ecosystem, so that each acre of soil produces more food than before. The economic beneifts of this new agricultural technology are appreciable, and self-evident. However, the economic advantage may be counter-balanced by the increased impact on the environment. This arises because, given the reduced humus content of the soil, the plant's roots do not efficiently absorb the added fertilizer. As a result an appreciable part leaches from the soil as nitrate and enters surface waters where it becomes a serious pollutant. Nitrate may encourage algal overgrowths which on their inevitable death and decay tend to break down the self-purifying aquatic cycle.

Excess nitrate from fertilizer drainage leads to another environmental impact, which may affect human health. While nitrate in food and drinking water appears to be relatively innocuous, nitrite is not, for it combines with haemoglobin in the blood, converting it to methemoglobin--which cannot carry oxygen. Unfortunately nitrate can be converted to nitrite by the action of bacteria in the intestinal tract, especially in infants, and can cause asphyxiation and even death. On these grounds, the U.S. public health service has established 10 ppm of nitrate nitrogen as the acceptable limit of nitrate in drinking water. In a number of agricultural areas in the U.S., nitrate levels in water supplies obtained from wells, and in some instances from surface waters, have exceeded this limit. Our own studies in the area of Decatur, Illinois, show quite directly that in the spring of 1970 when the city's water supply, which is derived from an impoundment of the Sangamon River, recorded 9 ppm of nitrate nitrogen, a minimum of 60 per cent of the nitrate was derived from inorganic fertilizer applied to the surrounding farmland.[4]

The effect of this change in agricultural technology is evident from Table 2, which compares the influence of the several relevant factors on the total environmental impact due to fertilizer nitrogen in 1949 and 1968. During that period the total annual use of fertilizer nitrogen, i.e. the total environmental impact, increased 648 per cent. The influence of population size increased by 34 per cent; the influence of crop production per capita (affluence) increased by 11 per cent; the influence of the change in fertilizer technology increased by 405 per cent. Clearly the last factor dominates the large increase in the total environmental impact of fertilizer nitrogen. Specifically, it should be noted that in 1949 about 11,000t fertilizer nitrogen were used per unit crop production, while in 1968 about 57,000t nitrogen were employed for the same crop yield. This means that the efficiency with which fertilizer nitrogen contributes to crop yield has declined fivefold. Obviously an appreciable part of the added nitrogen does not enter the crop and must appear elsewhere in the ecosystem.

The biological basis for this effect is shown in Fig. 5, which compares the corn yield in the State of Illinois, with the concurrent amounts of nitrogen fertilizer added to the soil.[5] This shows that as fertilizer levels increased, the yield per acre rose, but eventually levelled off due to the natural limits of plant growth. Thus, between 1962 and 1968, fertilizer usage doubled, but crop yield rose only about 10-15 per cent. Clearly at the higher levels of fertilizer usage an increasingly small proportion of the fertilizer contributes to the crop. The remainder leaches into surface waters. Thus, this innovation in agricultural technology sharply increases the environmental stress due to agricultural production.

Pesticides have created a similar situation. This is shown by the changes in the environmental impact index of pesticides between 1950 and 1967 (Table 3) In that time there was a 168 per cent increase in the amount of pesticides used per unit crop production, as a national average. By killing off natural insect predators and parasites of the target pest, while the latter often becomes resistant to the insecticides, the use of modern synthetic insecticides tends to exacerbate the pest problems that they were designed to control. As a result increasing amounts of insecticides must be used to maintain agricultural productivity. Insecticide usage is self-accelerating--resulting in both a decreased efficiency and an increased environmental impact.

Another technological displacement in agriculture is the increased use of feedlots for the production of livestock in preference to range feeding. Range-fed cattle are integrated into the soil ecosystem; they graze the soil's grass crop and restore nutrient to the soil as manure. But when cattle are maintained in huge pens, where they are fed on corn and deposit their waste intensively in the feedlot itself, the waste does not return to the soil. Instead it drains into surface waters where it adds to the stresses due to fertilizer nitrogen and detergent phosphate. The magnitude of the effect is considerable. At present, the organic waste produced in feedlots is more than the organic waste produced by all the cities of the U.S. Again, the newer technology has a serious environmental impact, and in this case has displaced a technology with an essentially zero environmental impact.

Textiles. Figure 6 describes changes in textile production since 1946. While total fibre production per capita has remained more or less constant, natural fibres (cotton and wool)have been significantly displaced by synthetic ones. This technological change considerably increases the environmental impact due to fibre production and use.

One reason is that the energy required for the synthesis of the final product, a linear polymer (cellulose in the case of cotton, keratin in the case of wool and polyamides in the case of nylon) is greater for the synthetic material. Although quantitative data are not yet available, this is evident from the comparison of two productive processes, shown in Table 4. Nylon production involves as many as 10 steps of chemical synthesis, each requiring considerable energy in the form of heat and electric power. In contrast, energy required for the synthesis of cotton is derived, free, from a renewable source--sunlight--and is transferred without combustion and resultant air pollution. Moreover, the raw materials for cellulose synthesis are carbon dioxide and water, both freely available renewable resources, while the raw material for nylon synthesis is petroleum or a similar hydrocarbon--non-renewable resources. Thus it seems that the environmental stress due to the production of such an artificial fibre is probably well in excess of that due to the production of an equal weight of cotton. This is only an approximation, for we need far more detailed, quantitative estimates, in the form of the appropriate environmental impact indices, that would also take into account the fuel and other materials used in the production of cotton.

Because a synthetic fibre such as nylon is unnatural, it also has a greater impact on the environment as a waste material, than do cotton or wool. The natural polymers in cotton and wool are important constituents of the soil ecosystem. Through the action of moulds and decay bacteria they contribute to the formation of humus. In this process cellulose is readily broken down. Thus, in nature, cellulose and keratin are not wastes, because they provide essential nutrients for soil microorganisms. Hence they cannot accumulate.

The contrast with synthetic fibres is striking. The structure of nylon and similar synthetic polymers is a human invention and does not occur in natural living things. Hence, unlike natural polymers, synthetic ones find no counterpart in the armamentarium of degradative enzymes in nature. Ecologically, synthetic polymers are literally indestructible. Hence, every bit of synthetic fibre or polymer that has been produced on the earth is either destroyed by burning--and thereby pollutes the air--or accumulates as rubbish. One result, according to a recent report, is that microscopic fragments of plastic fibres, often red, blue or orange, have now become common in certain marine waters.[6] For technological displacement has been at work in this area too; in recent years natural fibres such as hemp and jute have been nearly totally replaced by synthetic fibres in fishing operations. A chief reason for this use of synthetic fibres is that they resist degradation by moulds, which, as already indicated, readily attack cellulosic net materials such as hemp or jute. Thus, the property which enhances the economic value of the synthetic fibre over the nautral one--its resistance to biological degradation--is precisely the property which increases the environmental impact of the synthetic material.

Detergents. Figure 7 shows that synthetic detergents have largely replaced soap in the U.S. as domestic and industrial cleaners, with the total production of cleaners per capita remaining essentially unchanged. Soap is based on fat, which is reacted with alkali to produce the end product. Being a natural product, fat is extracted from an ecosystem (for example, that represented by a coconut palm plantation), and when released into an aquatic ecosystem after use, soap is readily degraded by the bacteria of decay. Since most municipal wastes are subjected to treatment which degrades organic waste to its inorganic products, in practice, the fatty residue of soap wastes is degraded by bacterial action within the confines of a sewage treatment plant. What is emitted to surface waters is only carbon dioxide and water. Hence, there is little or no impact on the aquatic ecosystem due to biological oxygen demand arising from soap wastes. Nor is the product of soap degradation, carbon dioxide, usually an important ecological intrusion since it is in plentiful supply from other environmental sources, and in any case is an essential nutrient for photosynthetic algae.

Compared with soap, the production of synthetic detergents is a more serious source of pollution. Once used and released into the environment, detergents generate a more intense environmental impact than a comparable amount of soap. Even the newer detergents which are regarded as degradable because the paraffin chain of the molecule (being unbranched, in contrast with the earlier non-degradable detergents) is broken down by bacterial action, nevertheless leave a residue of phenol which may not be degraded and may accumulate in surface waters. Phenol is a rather toxic substance, being foreign to the aquatic ecosystem.

Unlike soap, detergents are compounded with considerable amounts of phosphate in order to enhance their cleansing action and as a water softener. Phosphate may readily induce water pollution by stimulating heavy overgrowths of algae, in the same way as nitrate. Figure 8 shows that nearly all of the increase in sewage phosphorus in the U. S. can be accounted for by the phosphorus content of detergents. Since soap is quite free of phosphate, the environmental impact due to phosphate is clearly a consequence of the technological change in cleaner production.

The change in the environmental impact index of phosphate in cleaners between 1946 and 1968 is shown in Table 5. In this period the overall environmental impact index increased 1845 per cent. The increase in the effect of population size was 42 per cent; the effect of *per capita* use of cleaners did not change; the technological factor, i.e., that due to the displacement of phosphate-free soap by detergents containing an average of about 4 per cent phosphorus, increased about 1270 per cent. The relative importance of this change in cleaner technology in intensifying environmental impact is quite evident.

*Secondary environmental effects of technological displacements.* Increased production of synthetic organic chemicals leads to intensified environmental impacts in several different ways. This segment of industry has heavy power requirements; and in contributing to increased power production the industry adds to the rising levels of air pollutants that are emitted by power plants. In addition, organic synthesis releases into the environment a wide variety of reagents and intermediates, which are foreign to natural ecosystems and often toxic, thus generating important, often poorly understood, environmental impacts. An example is the enormous loss of fish and plant damage resulting from release of organic wastes, insecticides and herbicides to surface waters or the air.

Perhaps the most serious environmental impact attributable to the increased production of synthetic organic chemicals is due to the intrusion of mercury into surface waters. This effect is mediated by chlorine production. Chlorine is a vital reagent in many organic syntheses--about 80 per cent of present chlorine production finds its end use in the synthetic organic chemical industry. A considerable proportion of chlorine production is carried out in electrolytic mercury cells; until recent control measures were imposed on the industry, about 0.2-0.5 lb of mercury were released to the environment per ton of chlorine manufactured in this way. This means, for example, that the substitution of nylon for cotton has generated an intensified environmental impact due to mercury, for nylon production involves the use of chlorinated intermediates. The rapid, parallel rises in production of synthetic organic chemicals, of chlorine, and of the use of mercury for the latter, is illustrated in Fig. 9.

The displacement of steel and lumber by aluminium adds to the burden of air pollutants, for aluminium production is extremely power consumptive. Per lb of aluminium produced, about 29 860 BThU are required to generate the necessary electricity whereas only about 4615 BThU are used per lb of steel produced. Cement, which tends to displace steel in construction, is also extremely power consumptive. The production of chemicals, aluminium and cement account for about 28 per cent of the total U.S. industrial use of electricity.

*Packaging.* The displacement of older forms of packaging by 'disposable' containers, such as non-returnable bottles, is another example of the intensification of environmental impact due to the postwar pattern of economic growth. This is illustrated in Fig. 10 and Table 6. There has been a very striking increase in environmental impact due to beer bottles, which are not assimilated by ecological systems and are, in their manufacture, quite power consumptive. The major factor in this intensified environmental impact is the new technology--the use of non-returnable bottles to contain beer--rather than affluence with respect to *per capita* consumption of beer, or increased population. A recent study shows that the total expenditure of energy--for bottle manufacture, processing, shipping etc.--required to deliver equal amounts of fluid in non-returnable bottles is 4.7 times that for returnable ones.[7]

*Automotive vehicles.* Finally there is the problem of assessing the environmental impact of changes in patterns of passenger travel and freight traffic since 1946. Particularly important has been the increased use of automobiles, buses and trucks.

The environmental impact of the internal combustion engine is due to the emission of nitrogen oxides, carbon monoxide, waste fuel and lead. The intensities of these impacts, as measured by their levels in the environment, are a function, not only of the vehicle-miles travelled, but also of the nature of the engine itself--i.e. technological factors are relevant as well.

The technological changes in automotive engines since World War 2 have worsened environmental impact (Fig. 11). Thus, for passenger automobiles, overall mileage per gallon of fuel declined from 14.97 in 1949 to 14.08 in 1967, largely because average horsepower increased from 100 to 240. Another important technological change was in average compression ratio, which increased from about 5.9 to 9.5. This engineering change has had two important effects on the environmental impact of the gasoline engine. First increasing amounts of tetraethyl lead are needed as a gasoline additive in order to suppress the engine knock that occurs at high compression ratios. As shown in Fig. 12, annual use of tetraethyl lead has increased significantly in 1946-68. Essentially all of this lead is emitted from the engine exhaust and is disseminated into the environment. Since lead is not a functional element in any biological organism, and is toxic, it represents an external intrusion on the ecosystem and generates an appreciable environmental effect.

A second consequence of the increase in engine compression ratio has been a rise in the concentration of nitrogen oxides emitted in engine exhaust. This has occurred because the engine temperature increases with compression ratio. The combination of nitrogen and oxygen, present in the air taken into the engine cylinder, to form nitrogen oxides is enhanced at elevated temperatures. Through a series of light-activated reactions, involving waste fuel, nitrogen oxides induce the formation of peroxyacetyl nitrate, the noxious ingredient of photochemical smog. Smog of this type was first detected in Los Angeles in 1942-3; it was unknown in most other U.S. cities until the late 1950s and 1960s, but is now a nearly universal urban pollutant. Peroxyacetyl nitrate is a toxic agent to man, agricultural crops and trees; it has probably increased by about an order of magnitude in 1946-68.

The environmental impact indices for nitrogen oxides and lead are shown in Tables 7 and 8 respectively. The total environmental impact for nitrogen oxides increased by about 630 per cent between 1946 and 1967. The technological factor (the amount of nitrogen oxides emitted per vehicle-mile) increased by 158 per cent, vehicle-miles travelled per capita increased by about 100 per cent, and the population factor by about 41 per cent. In the case of tetraethyl lead, the largest increase in impact is in vehicle-miles travelled per capita (100 per cent), followed by the technological factor (83 per cent) and the population factor (41 per cent). Thus the major influences on automotive air pollution are increased per capita mileage (in part because of changes in work-residence distribution due to the expansion of suburbs) and the increased environmental impact per mile travelled due to technological changes in the gasoline engine.

A similar situation obtains with respect to overland shipments of inter-city freight. Here truck freight has tended to displace railroad freight. And again the displacing technology has a more severe environmental impact than does the displaced technology. This is evident from the energy required to transport freight by rail and truck: 624 BThU/t-mile by rail and 3462 BThU/t-mile by truck. It should also be noted that the steel and cement required to produce equal lengths of railroad and expressway differ in the amount of power required in the ratio 1 to 3.6. This is due to the rather power consumptive nature of cement production and to the fact that four highway lanes are required to accommodate heavy truck traffic. In addition, the divided roadway requires a 400 ft right-of-way while a train roadbed needs only 100 ft. In all these ways, the displacement of railroads by automotive vehicles, not only for freight, but also for passenger travel, has intensified the resultant environmental impact.

ENVIRONMENTAL IMPACT INVENTORY. The above analysis represents only small fragments of a complex whole. What is required is a full inventory of the various environmental impact indices associated with the productive enterprise and the identification of the origins of these impacts within the production process and of the ecosystems on which they intrude. Such an assemblage of data, representing an environmental impact inventory, is derived below as an exploratory exercise with reference to a productive item for which a certain amount of the data happen to be available--the production of chlorine and alkali by chlor-alkali plants employing mercury electrolytic cells.

The required data include (i) the environmental impact indices associated with the input goods, chiefly, electric power, salt and mercury; (ii) the environmental impact indices representative of the process wastes and the properties of the ecological systems which are affected by them; (iii) the environmental impact indices representative of the ecologically significant wastes associated with the process output goods (chlorine and alkali) and the environmental fate of this material.

Thus, the production of one megawatt of electricity by fossil-fuel burning plants results in the release of 34.20 lb sulphur oxides to the atmosphere. Since 4300 kWh is consumed by a mercury cell chlor-alkali plant, per ton of chlorine produced, on the average, 147 lb sulphur oxides are released to the environment per ton of chlorine produced. In this way the corresponding values for other power-plant pollutants--nitrogen oxides, dust--can also be computed.

The major ecologically-significant waste from chlor-alkali production is mercury metal. Two studies provide data on the amounts of mercury released to the air, to surface waters or buried in land-fill, per ton of chlorine produced. For example, per ton of chlorine produced, about 17-35 g mercury vapour is emitted to the air as waste. Chemical engineering data indicate a total 'mercury loss' of 0.2-0.5 lb per ton of chlorine for the process. This agrees rather well with the total losses to the environment estimated directly by the above studies: 0.13-0.57 lb mercury per ton of chlorine.

The present data indicate that as much as 20 g mercury may become incorporated in the alkali produced in the course of producing a ton of chlorine; this alkali is used in 42 separate products. From an input-output analysis of the chlor-alkali industry one could construct a comprehensive matrix for the movement of mercury contained in alkali through various manufacturing processes into the environment. Recently, economic input-output methods (Leontiev and Isard) have been adapted to include environmental externalities.[8] For the present purposes we shall restrict the analysis to a group of products--wood pulp and paper, soap, lye and cleansers--which use about 26 per cent of the alkali output. Hence, we may estimate that of every 20 g mercury which goes into alkali, 26 per cent or 5 g appears in these products. Their environmental fates are known: waste water containing cleansers goes into waterways, as do the fluid wastes from pulp and paper production; paper is eventually burned, releasing its mercury to the air as vapour.

The ecological data relevant to an environmental impact inventory for chlor-alkali are just beginning to be investigated. When metallic mercury is dumped into surface waters it sinks into the bottom mud, as droplets. There it may be acted on by certain species of bacteria which convert the mercury to an organic form, methyl mercury. While metallic mercury does not dissolve in water, methyl mercury does. Hence in this form the mercury is readily taken up by living organisms in the water, ultimately contaminating fish that may be eaten by people. In recent months it has been found that mercury wastes from a number of chlor-alkali plants have caused mercury levels in fish in adjacent surface water to exceed acceptable public health limits. Emitted into the air, mercury may be taken up directly by human beings through absorption in the lungs, or may be washed down into soil and water by precipitation--and thus enter into these ecosystems. Very little is known about the ecological transfer of mercury in the soil as yet. Finally, since mercury is very volatile, when heated (as in an incinerator) it is vaporized and emitted into the air. A recent study shows that St. Louis domestic incinerators emit about 2-3000 lb mercury into the air annually. Much of this originates in the incineration of paper and wood pulp products.

On the basis of such data one can now produce (in a quite incomplete and tentative form) an environmental impact inventory for chlor-alkali production. This is presented in Table 9.

SOME CONCLUSIONS. The data that have been presented reveal a functional connection between economic growth--at least in the U.S. since 1946--and environmental impact. It is significant that the range of increase in the computed environmental impacts agrees fairly well with the independent measure of the actual levels of pollutants occurring in the environment. Thus, the increase in environmental impact index for tetraethyl lead computed from gasoline consumption data for 1946-67 is about 400 per cent; a similar increase in environmental lead levels has been recorded from analyses of layered ice in glaciers.[9] Similarly, the 648 per cent increase in the 19-year period 1949-68 in the environmental impact index computed for nitrogen fertilizer is in keeping with the few available large-scale field measurements. Thus, field data show that nitrate entering the Missouri River as it traversed Nebraska in the six-year period 1956-62 increased a little over 200 per cent.[10] The environmental impact indices computed for several aspects of automotive vehicle use are also in keeping with general field observations. It is widely recognized that the most striking increase among deterioration due to automotive vehicles, is in the production of photochemical smog.

Since 1942 it has increased, nationally, by probably an order of magnitude, appearing in nearly every major city and even in smaller ones in the last five years. However, in the period 1946-68 total use of automotive vehicles, as measured by gasoline consumption, increased by only 200 per cent--an increment too small to account for the concurrent rise in the incidence of photochemical smog. It is significant that this disparity between the observed increase in smog levels and the increase in vehicle use is accounted for by the environmental impact index computed for nitrogen oxides, the agent which initiates the smog reaction, for that index increased by 630 per cent in 1946-67.

These agreements with actual field data support the conclusion that the computations represented by the environmental impact index provide a useful approximation of the changes in environmental impact associated with the relevant features of the growth of the U.S. economy since 1946. In particular, we can place some reliance on the subdivision of the total impact index into the several factors: population size, *per capita* production or consumption and the technology of production and use.

It is of interest to make a direct comparison of the relative contributions of increases in population size and affluence, and of changes in the technology of production, to the increases in total environmental impact which have occurred since 1946. The ratio of the most recent total index value to the value of the 1946 index (or to the value for the earliest year for which the necessary data are available) is indicative of the change in the total impact over this period of time. The relative contributions of the several factors to these total changes is then given by the ratios of their respective partial indices. *Figure 13* reports such comparisons for the six productive activities evaluated. The population factor contributes only between 12 and 20 per cent of the total change in impact index. For all but the automotive pollutants, the affluence factor makes a rather small contribution--no more than 5 per cent--to the total changes in impact index. For nitrogen oxides and tetraethyl lead from automotive sources, this factor accounts for about 40 per cent of the total effect, reflecting a considerable increase in the number of vehicle-miles travelled *per capita* since 1946. The technological changes in the processes which generate the various economic goods, contribute from 40-90 per cent of the total increases in impact.

In evaluating these results it should be noted that automotive travel is itself strongly affected by a kind of technological transformation: the rapid increase of suburban residences and the concomitant failure to provide adequate railraod and other mass transportation to accommodate this change. That the overall increase in vehicle-miles travelled *per capita* since 1946 (about 100 per cent) is related to increased residence-work travel incident upon this change is suggested by the results of a 1963 survey. It was found that 90 per cent of all automobile trips, respresenting 30 per cent of total mileage travelled, are 10 miles or less in length. The mean residence-work travel distance was about 5.5 miles. Thus, it is probably appropriate to regard the increase in *per capita* vehicle-miles travelled by automobile as not totally attributable to increased affluence, but rather as a response to new work-residence relationships which are costly in transportation.

During the period from 1946 to the present, pollution levels in the U.S. have increased sharply--generally by an order of magnitude or so. It seems evident from the data presented above that most of this increase is due to one of the three factors that influence environmental impact--the technology of production--and that both population growth and increase in affluence exert a much smaller influence. Thus the chief reason for the sharp increase in environmental stress is the sweeping transformation in production technology. Productive activities with intense environmental impacts have displaced activities with less serious environmental impacts; the growth pattern has been counter-ecological.

This conclusion is easily misconstrued to mean that technology is therefore, *per se*, ecologically harmful. That this interpretation is unwarranted can be seen from the following examples.

Consider the transformation of the present, ecologically-faulty, relationship among soil, agricultural crops, the human population and sewage. Suppose that the sewage, instead of being introduced into surface waters as it is now, whether directly or following treatment, is instead trasported from urban collection systems by pipeline to agricultural areas, where--after appropriate sterilization procedures--it is incorporated into the soil. Such a pipeline would reincorporate the urban population into the soil's ecological cycle, restoring the integrity of that cycle, and incidentally removing the need for inorganic nitrogen fertilizer--which also stresses the aquatic cycle. Hence the urban population is then no longer external to the soil cycle and is therefore incapable either of generating a negative biological stress on the aquatic ecosystem. But note that this state of zero environmental impact is not achieved by a return to 'primitive' conditions, but by an actual technological advance--the construction of a sewage pipeline system.

Or consider the example provided by the technological treatment of gold and other percious metals. Gold is, after all, subject to numerous technological manipulations, which generate a series of considerable economic values. Yet we manage to accomplish all of this without intruding more than a rather small fraction of all the gold ever acquired by human beings into the ecosphere. Because we value it so highly very little gold is 'lost' to the environment. In contrast, most of the mercury which has entered commerce in the last generation has been disseminated into the environment, with very unfortunate effects. Clearly, given adequate technology--and motivation--we could be as thrifty in our handling of mercury as we are of gold, thereby preventing the entry of this toxic material into the environment. Again what is required is not necessarily the abandonment of mercury-based technology, but rather the improvement of that technology to the point of satisfactory compatability with the ecosystem.

Generally speaking then, it would appear possible to reduce the environmental impact of human activities by developing alternatives to ecologically-faulty activities. This can be accomplished, not by abandoning technology and the economic goods which it can yield, but by developing new technologies which incorporate not only the knowledge of the physical sciences but ecological wisdom as well.

From the foregoing considerations, a number of conclusions can be drawn.

1. The deterioration of the environment, whatever its cost in money, social distress and personal suffering, is chiefly the result of the ecologically-faulty technology which has been employed to remake productive enterprises.

2. The resulting environmental impacts stress the basic ecosystems which support the life of human beings, destroy the 'biological capital' which is essential to the operation of industry and agriculture, and may, if unchecked, lead to the catastrophic collapse of these systems.

3. The environmental impacts already generated are sufficient to threaten the continued development of the economic system--witness the current difficulties in the U.S. in siting new power plants at a time of severe power shortage, the recent curtailment of industrial innovation in the fields of detergents, chemical manufacturing, insecticides, herbicides, chlorine production, oil drilling, oil transport, supersonic aviation, nuclear power generation, industrial uses of nuclear explosives--all resulting from public rejection of the concomitant environmental deterioration.

What has been the actual cost of the degradation which has been the response of the environmental system to the intensified impacts upon it? This is, of course, a very difficult question. As indicated earlier, the theory which links environmental impact to ecological effect is for the most part poorly developed. At the same time there are formidable difficulties confronting the economist who attempts to return the 'externalities' represented by ecological damage to the realm of economic evaluation. These efforts, which appear to be developing increasingly useful information, need not be reviewed here. For there is, I believe, a simpler and more direct way to express the cost to the economic system represented by environmental deterioration.

It seems to me that a meaningful way to evaluate this cost is along the following lines. Given conditions 1, 2 and 3 above, it seems probable, if we are to survive economically as well as biologically, that much of the technological transformation of the U.S. economy since 1946 will need to be, so to speak, redone in order to bring the nations's productive technology much more closely into harmony with the inescapable demands of the ecosystem. This will require the development of massive new technologies including: systems to return sewage and garbage directly to the soil; for the replacement of synthetic materials by natural ones; to support the reversal of the present trend to retire soil from agriculture and to elevate the yield per acre; for the development of land transport that operates with maximal fuel efficiency at low combustion temperatures; to enable the sharp curtailment of the use of biologically active synthetic organic agents. In effect what is required is a new period of technological transformation of the economy, which reverses the counter-ecological trends developed since 1946. We might estimate the cost of the new transformation, from the cost of the former one, which must represent a capital investment in the range of hundreds of billions of dollars. To this must be added, of course, the cost of repairing the ecological damage which has already been incurred, such as the eutrophication of Lake Erie--again a bill to be reckoned in the hundreds of billions of dollars.

The enormous size of these costs raises a final question: Is there some functional connection in the economy between the tendency of a given productive activity to inflict an intense impact on the environment (and the size of the resultant costs) and the role of this activity in economic growth? For it is evident from even a cursory comparison of the productive activities which have rapidly expanded in the U.S. economy since 1946 with the activities which they have displaced, that the displacing activities are also considerably more profitable than those which they displace. The correlation between profitability and rapid growth is one that is presumably accountable by economics. Is the additional linkage to intense enviornmental impact also functional, or only accidental?

It has been pointed out often enough that environmental pollution represents a long-unpaid debt to nature. Is it possible that the U.S. economy has grown since 1946 by deriving much of its new wealth through the enlargement of that debt? If this should turn out to be the case what strains will develop in the economy if, for the sake of the survival of our society, that debt should now be called? How will these strains affect our ability to pay the debt--to survive?

# PREFACE TO: III.

# ORGANIZING FOR ENVIRONMENTAL MANAGEMENT

To organize, according to Talcott Parsons, is to "construct human groups to seek specific goals." In another view Chester Barnard sees organization as a "system of consciously coordinated activities or forces of two or more persons." Thus, it is easy to understand why "organization" can be called perhaps the most fundamental tool in the manager's repertoire.

The importance of organizational design was emphasized in early public administration theory. This overriding concern with structure exemplified in the form of the now too-familiar organization chart, came under much criticism for being too mechanistic and not representative of actual organizational behavior. However, H. George Fredrickson points out in Recovery of Structure in Public Administration that "organization" is once again recognized for being an important factor for managers. Herbert Simon agrees, writing in his Administrative Behavior that "organization is important, first, because in our society where men spend most of their waking adult lives in organizations...this environment provides much of the force that molds and develops personal qualities and habits. Organization is important, second, because it provides to those in responsible positions the means for exercising authority and influence over others."

A discussion of organization is particularly relevant to this anthology because of the special administrative problems that environmental concerns cause managers. In the first selection in this section, Lynton Caldwell discusses "Environmental Quality as an Administrative Problem." He distinguishes environmental quality from other issues addressed by managers because of its comprehensiveness, its relevance to the "future," and its reliance on science. He concludes that the ultimate task of environmental quality agencies is one of synthesis and that since current administrative organizations do not lend themselves to a systematic, interdisciplenary approach, major changes in structure are necessary.

This point is amplified by Frank Grad in his article on "Intergovernmental Aspects of Environmental Controls." He traces the development of environmental standards (air, water, noise, and solid waste) and their administration at the federal, state and local levels. Grad identifies several legal and administrative constraints to effective environmental management. Among the primary constraints are: (1) lack of integration between development programs and pollution control programs; (2) lack of coordination between pollution control programs, (3) fragmented responsibility between levels of government; and (4) inadequate legal authority, especially for local and municipal governments.

It is difficult to ignore the logic of Caldwell's and Grad's argument that the interdependant nature of environmental systems requires a comprehensive coordinated response. This is not likely to be possible given the existing fragmentation of responsibilities among various agencies. Consequently, federal, state and local governments continue to search for a more effective organization for managing environmental programs. President Nixon's reorganization plan includes a proposal to create a "super" Department of Natural Resources in order to pull together the remaining scattered environmental responsibilities. While Congress has not yet approved this plan, the President has attempted to accomplish the substance of the reorganization through informal means, principally by designating the Secretary of Agriculture to be his counselor for natural resources.

Several state governments have undertaken or are planning similar reorganizations. A recent report by Elizabeth Haskell identified fifteen states that have consolidated pollution control and natural resource programs into new departments. These departments range from small commissions with responsibilities for air and water pollution (e.g., South Carolina, North Carolina, and Mississippi) to "super" departments (e.g., Illinois, Minnesota, New York, Washington, and Wisconsin).*

The administrative dilemmas facing local governments in managing the environment may possibly be more critical, because local officials bear the responsibility for resolving environmental problems where they occur, e.g. someone's backyard. From rather modest beginnings with control over public sewers, local governments today have assumed a broad range of environmental responsibilities. Air pollution, water pollution, noise, solid waste disposal have all become primary concerns. The traditional response of local governments to these problems has been to establish separate organizational units for each, e.g., a water department, a sewer department, a refuse department. However, several local governments have established new centralized environmental agencies. The duties of these may consist mainly of enforcement functions, e.g., New York City, or policy coordination (staff) function, e.g. Austin, Texas. Alternatives to establishing new departments or agencies is to expand the functions of an existing agency, e.g. Erie County, Pennsylvania Health Department; Dallas, Texas or Inglewood, California Planning Departments. A third alternative is to develop a team of managers to serve a coordinating function, e.g. Nashville-Davidson County.

Since many environmental problems do spill over local political boundaries, a regional approach of some type is often suggested. Joseph Zimmerman reinforces this point in the next article, "Pollution Abatement by Regional Action." Zimmerman proposes several alternative regional administrative structures to handle environmental, as well as other problems, including ecomenical model, Twin Cities model, special district model, metropolitan county model, metropolitan consolidation model, metropolitan Toronto model, and the compact model. Each of these are briefly described and analyzed. Often environmental problems are found to give impetus to developing a regional approach.

Another view of regional environmental management is given in this section's final article, "An Analysis of Institutional Forms for Integrated Regional Environmental Management," by Edwin Coate. Coate provides a case study of environmental management in San Diego County. Based on the experience in the case study, a model is proposed for achieving regional environmental management and four alternatives for implementation are suggested.

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*Elizabeth Haskell. Managing the Environment: Nine States Look for New Answers. April, 1971.

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# ENVIRONMENTAL QUALITY AS AN ADMINISTRATIVE PROBLEM

Lynton K. Caldwell*

The advent of environmental quality as a public issue has presented government with a problem of organization and management that, if not entirely new, is unprecedented in its scope and complexity. Although some of its components are traditional functions of government--water supply, for example--it differs in the aggregate from most other public services. Unlike many regulatory and client-centered programs, the environmental issue is concerned with the impact of everyone upon the environment.

This "everyone" is more abstract than the usual objects of governmental action: as, for example, farmers, airlines, veterans, or the unemployed. It includes the total range of human activities that significantly affect man's environment. But it does not deal with the totality of these activities--only with those aspects that relate to the quality or condition of the environment. It must also deal with these activities in a time context uncongenial to practical politics; it must consider long-term and accumulative consequences. In order to act effectively on many environmental issues, government must act *before* the issue becomes acute, and this often means before the public generally is aware of the need for or receptive to taking public action.

Despite their breadth and complexity, it is easier to define environmental issues than it is to specify the content of even more abstract concepts such as social justice, equal opportunity, or national security. The environment itself is tangible and measurable, even though some of the values perceived or sought in it are not. Many people, however, find environmental concepts difficult to comprehend; these concepts often require a way of thinking about man-environment relationships that are contrary to or absent from conventional assumptions. Governments have consequently found it difficult to define environmental issues adequately.

## Defining Policy Objectives

The origin of environmental policy, and hence of its administration, is to be found in the political movement that made environmental quality a public issue. Although the environmental issue relates to everyone, all are not equally concerned. Some are more interested and informed than others, some are more directly affected by the administration of environmental policies. The tasks of the administrator are obviously influenced by who is concerned, how, and with what intensity.

In the United States, environmental policy has developed from the "grass roots," as a popular movement. But its leaders and more influential followers have come from the upper levels of society as measured by income and education.

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More than perhaps any other issue, the environment has become an object of concern among the professional occupations, especially among scientists, engineers, and physicians. Organized groups, such as the Scientists Institute for Public Information, the National Sanitation Foundation, and various civic and professional associations, have campaigned for public awareness of environmental issues and for enactment of protective legislation and its effective implementation by public agencies.

The environmental administrator therefore faces an active sector of the public that is exceptionally knowledgeable about the issues with which he is concerned--some members of which may be better informed on substantive matters than the administrator himself. This activist group, moreover, possesses the information, skills, and relationships necessary to get policies adopted and administered in a complex technological society. Its influence may be disproportionate to its numbers, but it represents the kind of politics that may become more common as issues increasingly involve scientific knowledge and methods of analysis that depend upon more than the average amount of formal education.

Foresight with respect to possible futures is more often a characteristic of the highly educated man and the scientist than it is of people generally. The environmental issue is especially dependent upon calculations of trends and projections of probable futures. But actual determination of the kind of future toward which public policies are directed is a form of political action. Long-range and comprehensive national planning is implied in the solution of many environmental problems. Yet this type of planning has not generally been acceptable to any major sector of American politics. The search for market mechanisms (such as effluent charges) or technological fixes (such as bio-degradable containers) is, in part, motivated by dislike and distrust of comprehensive environmental planning and administration.

It seems improbable, however, that "the invisible hand" of economic self-interest or the inventive ingenuity of technologists can resolve all of modern societies' environmental problems. They do not afford means for defining policy objectives, and are to some extent advocated by persons who dislike the idea of government having other than the most general objectives in relation to the environment. But, contrary to the opinions of some skeptics, environmental quality is not merely a transient enthusiasm that will wane when the costs of environmental amenities are confronted. The problems that man faces in his environment, and especially those that he has created for himself, will not diminish or disappear without human intervention. Enthusiasm may diminish, but the problems can be expected to remain and often to intensify. Honest and comprehensive analyses of environmental problems and their possible solutions, free from preconceived assumptions, are needed as bases for choice among identified, alternative courses of action. Unfortunately, this approach to policy-making is as yet very imperfectly developed in government anywhere.

Environmental problems are seldom of the kind that yield to the adversary procedures characteristic of American politics and litigation. Environmental issues are characteristically manifest in the form of problems and so require a problem-focused approach. Their tests of truth tend to be those of science rather than those of conventional politics. To the extent that verifiable tests of science can be applied to practical problems of the environment, the conventional ground rules of politics and administration may possibly be changed. The scope and direction of public administration would to this extent be channeled by the demonstrable facts of issues. The personal latitude of the politician and administrator would be reduced as the parameters of a decision became more restricted through clarification of the problem. But, conversely, environmental problems are often amenable to alternative solutions, each of which entails its own set of consequences.

The public official may thus have his latitude for judgment simultaneously narrowed with respect to the problem and broadened with respect to solutions, but not necessarily for action.

The technical feasibility of a "solution" carries no promise of political feasibility. The environmental administrator may therefore find that his problems are increasingly defined for him by scientists, beyond his jurisdiction and control, and that the available solutions cannot be implemented without inter-agency or inter-governmental cooperation, also beyond his control. Regulatory policies and procedures are of uncertain life-expectancy; they are subject to unpredictable changes in knowledge or technology. In the United States, for example, air and water pollution policies have been in an almost continuous state of change. Regulation of foam and phosphates in household detergents offers a familiar illustration of a much larger number of unstable policy issues. Clearly, environmental quality objectives pose organizational and procedural problems with which public administration, as we have known it, has not been well prepared to cope.

In the necessity for interrelating policy and procedure, structure and strategy, environmental administration is not unique; but, for effective results, there is no area of public affairs in which the necessity is more compelling. Even military operations may not be more exacting, for national strategy need only be more effective than that of a fallible enemy that may be subverted or may make mistakes. But the processes of the natural world cannot be propagandized, nor does "nature" make what men call "mistakes." And, in addition, environmental policy requires for its successful implementation that which men have always found most difficult--collective self-control.

Defining policies with respect to man's future environments is, therefore, a very large, complex, and continuing process. It is an integrative process that must transcend the compartmentalization of governmental functions and jurisdictions and must provide continuing communication among all sectors of society having significant environmental concerns. Governments have nowhere attempted to do this and, accordingly, have not been structured to do it. As they now attempt to cope with environmental problems, they are certain to encounter difficulties presented by unsuitable structures for the formulation and administration of effective environmental policies.

## Finding Appropriate Structures

The unsuitability of the present governmental structure for the formulation and administration of environmental policy is a consequence of its ad hoc historical evolution. The committees of the United States Congress and the bureaus of the Executive Branch are largely client-centered or process-oriented. At all governmental levels, functions have been added one at a time, in response to specific needs or importunities. Very little attention has been given to the broad purposes or missions of government at different levels. Aphorisms or "practical" assumptions have largely guided reorganization efforts. There is nothing wrong with being practical, but there is danger in the uncritical acceptance of assumptions in relation to their probable effect upon the outcome of reorganization efforts.

The unsuitability of existing governmental structure for environmental purposes lies in its tendency to make for exclusiveness among its specialized divisions and for legalized inflexibility in the administration of its programs. Under Section 102 of the National Environmental Policy Act,

> The Congress authorizes and directs that all agencies of the Federal Government shall--(A) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and decisionmaking which may have an impact on man's environment.

In actual fact, implementation of this directive is impeded by the way in which the federal agencies are organized and the way in which their missions have been defined by law and historical experience. On the highly theoretical assumption that the Office of Management and Budget or the congressional appropriations committees would authorize funds specifically to implement this statutory provision, it is, nevertheless, doubtful that many agencies will voluntarily modify their procedures in this direction.

In some cases, of which the Bureau of Reclamation may offer an example, the agency mission may have been so conceived and so defined that the principal effect of "a systematic, interdisciplinary approach" could be to call the agency's mission into question. Perhaps this was a possibility foreseen in the drafting of the statute, but it is not to be expected that any human organization, including any outside of government, is likely to carry self-examination to this "extreme." But, even if the agency's mission is confirmed by broad environmental considerations, application of "a systematic, interdisciplinary approach" is likely to intrude into areas that have been assigned by law to other agencies. Given the specialized basis of administrative organization in the United States, interdisciplinary approahces are likely to imply inter-agency conclusions.

Governmental administration, for all its complexity, tends to be simplistic in relation to its problems. It is especially deficient in the skills of policy synthesis and administrative adaptation. These skills have not traditionally been encouraged in the American public service.

But, to cope with the problems of a rapidly changing world, governments need powers that have traditionally been perceived as dangerous. Qualities of flexibility and adaptability in administration suggest discretion and unpredictability. A traditional method of enforcing accountability is through a precise and invariant specification of rules and procedures. If, however, an administrator is held accountable primarily for specified results, it becomes contradictory to bind him too tightly in choice of means.

Finding a structure appropriate to effective performance and accountability is not a one-time effort; it is a continuing task in a changing world. High among the qualities of such a structure must be flexibility and adaptability. Implementation of these qualities depends not only upon statutory and executive authorization on substantive matters, but also upon consistent budgetary and personnel policies. For example, realistic phase-out of redundant agencies and programs cannot be accomplished without workable plans for the transfer and reassignment of personnel. Program and performance budgeting are in principle the right approaches to fiscal flexibility. But statutory authorization to spend continues to be viewed in some agencies, and by some Congressmen, as an indefinite mandate for continuing implementation. For example, proposals to de-authorize water resource projects approved by Congress, many years before the enactment of a national environmental policy, are hardly more easily entertained by the Bureau of Reclamation or the Corps of

Engineers than proposals to repeal the Ten Commandments would be among Jews and Christians.

The reorganization of the Executive Branch proposed by President Richard Nixon on March 25, 1971 seems in some respects to be a step in a direction that would better serve a national policy for environmental quality. His recommendation for a super-department of natural resources provides a more logical grouping of related functions than that now prevailing. It could facilitate coordination among environmental impact programs and might tend to force policy decisions, both in Congress and the Executive Branch, into a broader, longer-range context. The President has surely been right in calling for a reconstituting of executive agencies to serve the broad ends or purposes of government. It is a welcome corrective to the ad hoc and incremental approach that has long been the almost unquestioned formula for "practicality" in governmental reorganization.

Nevertheless, the President's proposal has some serious weaknesses. Both his message to the Congress and the Memorandum of the President's Advisory Council on Executive Organization (Ash Council) upon which it was based gave less than adequate consideration to the criteria underlying executive reorganization. Some criteria were identified, but more attention should have been given to their implications in a proposal of such far-reaching importance and effect. It would have been especially useful to have accompanied the proposed restructuring with plans and procedures for the subsequent evaluation of its effectiveness and for modifying and correcting its arrangements in the light of experience and of specified criteria, not only for effectiveness but for responsiveness and responsibility. Some important questions regarding the implications of the reorganization for the exercise of public initiative and authority do not appear to have been considered. They are likely to be asked, however, in such congressional hearings as may eventually be held on the reorganization bills.

Restructuring for environmental administration, other than through specific incremental improvements, belongs to a much larger effort to redefine the purposes and functions of the federal government. For this great task, nothing less than a joint presidential-congressional national commission seems appropriate. Its membership should consist of individuals whose experience, thoughtfulness, and ability to transcend parochial and special-interest representation has been attested by past performance. The President's reorganization plan could constitute an appropriate point of departure for this commission.

It is possible that the proposals for structural change growing out of this broader-based review might not differ greatly in form and function from those recommended by the Ash Council. The very important difference should be in the philosophy of federal public service and rationale for executive reorganization that the President and his advisers did not adequately provide. For it is not enough to know how agencies are to be brought together functionally. It is equally, if not more, important to know how this relationship is to affect goals and strategies.

The Council on Environmental Quality (CEQ), for example, has been established as a statutory agency in the Executive Office of the President. Its history during the first two years of its existence has been primarily the administration of Section 102 of the National Environmental Policy Act of 1969. Its situation in the Executive Office has been a source of both strength and limitation. Implicit in its statutory organization is a leadership role in the formulation of national environmental policy. But constitutional prerogative in policy definition rests with the President and the Congress. The council's influence on policy must therefore be indirect and persuasive. It possesses the structure and mandate needed for policy leadership, but its political base is less adequate. Unlike the Council of Economic Advisers, it has no specific joint committee in the Congress to receive and consider its reports. It may not be able to differ greatly from predominant viewpoints in the Executive Branch. Thus, the mere existence of a high-level advisory body on environmental policy issues is no guarantee that its views will be considered or that it will even formulate policy positions to recommend to the President and the Congress. Changes in its political milieu would be required if it were to become a major independent force for policy formulation.

The environmental issue implies a new outlook and emphasis in American government, in many respects contradictory to hitherto prevailing assumptions. Past assumptions are reflected in the present structure. Unless a new structure facilitates the new purpose--consistent with other major objectives--the results will be frustration, disappointment, and a continuing decline of public confidence in government. Much more is at stake than government's handling of environmental issues, important as they may be.

## Developing Effective Procedures

Whatever the structure, a variety of methods are available to give effect to environmental policies. These methods, or approaches, to policy objectives fall into four general sets. They are not, however, fully comparable or alternative. No single approach leads to all desirable objectives. They are, in brief:

1. Self-executory; for example, the pricing of pollution and other forms of environmental degradation through taxes, licenses, and rebates.

2. Self-helping; for example, establishment of "environmental rights" which may be enforced through judicial action.

3. Technological; for instance, specifications regarding applications of technology; assistance for development of ameliorating technological innovations.

4. Administrative; for instance, air and water quality standards; controls over emissions, land use, waste disposal, and other environment-affecting behaviors.

All these approaches have been undergoing rapid change. It would not be useful to dwell upon them here in any great detail. Because no one of them answers all purposes and each has certain advantages, their use in combination offers optimal implementation of environmental policies.

## Self-Executory Approach

The self-executory approach minimizes governmental regulation, and through taxes or other fiscal devices is designed to cause polluters to adopt environmental protection measures in their own economic self-interest. The effectiveness of this approach depends on the availability of effective protective technologies and the pricing of the so-called "right to pollute" to discourage as much pollution as is economically feasible. This method is most readily applicable to those aspects of environmental policy having to do with pollution and consumption. Simplicity and economy of administrative costs are in its favor. It deserves to be used more extensively--for example, to reduce redundant outdoor advertising.

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## Self-Help Approach

The self-help approach also reflects a reluctance to depend upon public administration for environmental protection. Its advocacy has often been premised on the unwillingness of the public agencies to protect the environmental "rights" of the individual citizen. The tendency of regulatory agencies to become symbiotically associated with the interests regulated is cited as a reason for preferring a tangible court order to the will-o-the-wisp of administrative action. "Sue the bastards" has been the motto of the more determined environmentalists, but litigation is a method also available to environmental protection agencies in government, and it has been used. The law permitting, self-help remains the ultimate resort when all other methods fail.

The class-action suit has rapidly become the major method by which individual citizens have collectively challenged governmental action on environmental issues. This remedy, however, was sharply attacked by Solicitor General of the United States Erwin N. Griswold, in defending the government against a suit brought by the Sierra Club to enjoin the departments of Agriculture and the Interior from permitting a multimillion dollar tourist and commercial recreation facility to be developed in a national forest and wildlife refuge area in Mineral King Valley in California. In argument before the Supreme Court, the Solicitor General declared that if environmental class-action suits continued to be permitted and to be carried to the Supreme Court, he would ". . .find it very difficult to think of any legal issue arising in government which will not have to await one or more decisions in court before the administration charged with enforcing the law can take action."

## Technological Approach

Technological solutions are also sought, in part, to obviate a need for regulatory action. If technology can be employed to solve the environmental problem without inducing unwanted side-effects, it is the ideal protective approach. For example, since low-voltage power lines can be economically placed underground, esthetic and safety regulations regarding their overhead placement are becoming less important. Recycling and recovery technologies could greatly reduce enforcement costs of air and water pollution control. Government assistance for research and development in environmental protection technology should, therefore, be understood as a method of administering environmental protection policy.

## Administrative Approach

Administrative regulation implies surveillance and control of environment-affecting behavior. It extends from standard setting and quality control enforcement, as administered by the Environmental Protection Agency, to the outright management of environmental services, chiefly at state or local levels of government. In part, regulation is evidence of the inadequacy, or inadequate use, of the aforementioned procedures. For example, total elimination of internal combustion automobile engines or of factory stack emissions would remove the need for their regulation--but might create a new need in some other respect.

## Public Ownership

Public initiative and direct management are often more effective approaches to environmental objectives than attempts to regulate. For example, public planning of urban growth and of land use could hardly be less effective than attempts to regulate the private interest performance of these activities. Public ownership of land could--not inevitably would--greatly facilitate the reshaping of America's urban and rural environments. Popular prejudice against extensive public ownership and direct management of land has become increasingly irrational, as the great mass of Americans would tend to benefit from it and only the relatively few who are successful speculators and developers would be disadvantaged.

Rational choice among administrative procedures cannot be made without considering the institutional and political setting in which action is to occur. In the United States, the complexity and uncertainty of this setting argues in favor of a pluralistic or multi-instrumental approach. If no single method or group of methods appears clearly to be the answer to an administrative need, the course of wisdom may be to try anything that has any plausible possibility of success. In any case, as we have noted, the problems of the human environment differ to a degree that precludes any "best method" as a panacea for dealing with them collectively.

## A Task of Synthesis

The task of environmental administration may most realistically be understood as a part of the price that man must pay for taking control of evolution from natural forces. Since the beginning of history, man has progressively substituted artificial systems of his own contrivance for direct dependence on natural systems. Nature, however, maintains her own systems, but not man's. Human technologies are not self-renewing; all eventually run down or wear out, and all are ultimately dependent upon the continuing operation of the natural systems of the biosphere from which they derive their energy or substance. The survival of civilized man is thus contingent upon maintaining his own contrived systems and their essential bases of support in the natural world. Environmental administration has now become necessary, because the unprecedented expansion of human population and technology has imposed stresses upon all systems, natural and artificial; these stresses threaten the survival of the systems, and hence the survival of civilized man.

Reduced to essential terms, the task of environmental administration may be defined as integrating the operation of man's artificial systems with those of the natural world. The objective of this task is the satisfaction of human needs and values, qualitative as well as quantitative, psychological as well as material, esthetic as well as economic. The environmental crisis is a consequence of maladjustments among the systems of man and those of nature, and resource depletion, pollution, and qualitative deterioration of the environment are consequences. In most cases, the human error is to extract from the environment more than natural systems can renew or to overwhelm their capacity to absorb and recycle the residual products of man's activities.

To optimize relations between artificial and natural systems it is chiefly necessary to avoid constructing man-made systems in places and in ways that unnecessarily destroy benefits that man is receiving from natural systems. Wherever natural systems are, in effect, working for man--producing effects beneficial to human welfare--artificial systems should intrude only after a careful weighing of probable gains and losses. Examples of need for better systems articulation may be found in human developments affecting coastal, estuarial, and inland marshlands, in the practices of surface mining, in highway and airport construction, and in the sub-division of land for residential and industrial purposes. Not all natural systems operate to human advantage, but environmental disorders result more often from human interference with those that are beneficial

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than from adverse effects--for instance, climatic change or continental subsidence--attributable primarily to "nature."

The tasks of systems articulation are too varied, complex, and dynamic to be dealt with solely through automatic or self-executory means. Engineering and administration based on verifiable scientific research are unavoidable tools of public policy directed toward simultaneous advancement of civilized conditions and the maintenance of man's natural life-support systems.

The task of environmental administration, therefore, implies a systems or holistic approach to its mission. For example, the organization of the Environmental Protection Agency was strongly influenced by the interconnections among the forms and manifestations of pollution, and the flow and transformation of pollutants through the various media of the biosphere. The structure of the EPA should enhance the possibility of its effectively integrating environmental protection measures with the operations of man-made and natural systems.

The emerging recognition of need for international institutional arrangements for environmental protection and control has stimulated serious examination of the kinds of administrative structures and procedures that might be feasible and effective within the present configuration of world politics. Illustrative of one of the more detailed and carefully thought out analyses of the problem of international environmental administration is a report to the United States Department of State by the Committee on International Environmental Programs of the National Academy of Sciences.[1] It is becoming increasingly clear that effective control over man's impact upon his environment will require concerted action at all political levels, from local to global. Administrative regulation for environmental protection and control will, in the nature of the problems encountered, increasingly be seen as an intergovernmental and transnational problem for which new institutional arrangements and administrative procedures will be required. To those familiar with past failures of international control efforts, this prospect may seem utopian. But it may be even more utopian to believe that nations can continue indefinitely to serve their perceived short-range, exclusive interests without regard for the ultimate consequences of environmental degradation. National action on environmental issues in the future seems certain to take place against a background of international concern to a degree seldom found with regard to more clearly localized domestic issues.

The ultimate task of environmental quality agencies at all political levels, and especially at the top of each administrative hierarchy, is a task of synthesis. This consideration implies a structure and a criterion for personnel selection that will facilitate the integrative synthesizing functions of the work to be done. To achieve their intended effects, and to avoid unintended consequences, administrative regulations for environmental control should be developed within a general strategy for reaching a specified state of future environment. Such a strategy would require consideration of such basic issues as the numbers and distributions of future populations, the emphasis of the economic system, the role of science in society, and the suitability of institutional arrangements for accomplishing agreed-upon purposes. At whatever political level these tasks are undertaken, their relationship to action at other levels must be considered if effective results are to be obtained.

Attention to the technical and tactical aspects of environmental administration will always be required. It is important to monitor their effects, not only upon the specific environmental problem with which they are concerned, but also upon the operations of the relevant socio-ecological system as a whole, and this may, in some instances, imply international surveillance. Administrative policy and organization should provide for this need, as they do in the separation of the policy and surveillance functions of the Council for Environmental Quality from the operational functions of the EPA and other environment-related control agencies. It would accordingly be a major strategic error to remove the CEQ from the Executive Office of the President to a "line operation" in a department of natural resources or environment--a possibility implied in the Ash Council Report. The only feasible move would be a lateral move into a national planning agency, independent of personal control by the President and equally answerable to the Congress. This development would be improbable unless presidential government were to be modified, perhaps informally, in the direction of cabinet responsibility. An executive branch of hardly more than seven super-departments would seem to increase the feasibility of such a possibility.

If the growing problems of the environment are as serious as even moderate observers believe, major changes in the structure and procedures of public administration are unavoidable. These changes can be avoided only if the problems spontaneously disappear, or society proves unable or unwilling to cope with them. Each of these eventualities seems less probable than the probability of institutional change.

# NOTES

[1] The Institutional Implications of International Environmental Cooperation. A Report to the Department of State by the Committee for International Environmental Programs (Washington, D.C.: National Academy of Sciences, November 1, 1971).

# INTERGOVERNMENTAL ASPECTS OF ENVIRONMENTAL CONTROLS

Frank P. Grad*

The scope of "environmental law" has seen such rapid expansion in the recent past that any attempt to analyze the part played in it by the federal, state and local governments must first face the problem of selection of an area in which intergovernmental considerations have made a significant difference. Although aspects of conservation and resource development are touched at a number of points, the emphasis of this paper is on the control of environmental pollution--including air and water pollution, solid waste, noise and radiation pollution. There are several reasons for this emphasis. Problems of pollution are the most widespread, and many of their aspects are most acute. Moreover, there is a well-developed technology for the control of many pollutants, and all that is required for their successful management is the proper regulatory machinery, properly staffed and financed. Perhaps more important, environmental pollution is a significant metropolitan and urban problem, and in consequence affects more people than other aspects of environmental management. Because it is largely an urban, metropolitan problem, environmental pollution commonly requires the efforts of more than any one single government for its control. Indeed, environmental pollution has become an intergovernmental problem because its dimensions can no longer be contained within the narrow boundaries of municipal or local jurisdiction.

## THE ROLE OF THE FEDERAL GOVERNMENT IN THE FORMULATION OF ENVIRONMENTAL POLICIES AND STANDARDS

The historical development of federal involvement in environmental controls has followed a somewhat parallel pattern in almost every aspect of pollution control except in the case of radiation pollution, which the federal government has viewed as a matter of national concern from the very beginning of the development of nuclear energy.[1] In all other areas of environmental controls, however, the federal government has moved from a position of self denial of powers to an ever stronger assertion of federal interest. This is understandable because the control of the environment --in the traditional sense--for the health, safety and welfare of the people--be it in the area of water pollution, air pollution or noise--had long been regarded as a proper area for the exercise of the police power by the several states.[2] The federal government, as a government of limited and delegated powers, had never regarded itself as a repository of a general police power, even though "the federal police power" has sometimes been mentioned in a somewhat metaphoric sense.[3] The federal government has involved itself in environmental controls rather gradually. Reliance on the commerce power in the direct control of pollution is the most recent phenomenon of federal regulation; initially it operated indirectly through the federal government's power to tax and spend for the general welfare. Thus, in most fields of pollution control the federal involvement begins not with an assertion of federal regulatory power but through sponsorship of graint-in-aid programs, with federal standards

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gradually being imposed as a condition of the receipt of federal funds for purposes of environmental control. This traditional Congressional approach to the pollution control problem is exemplified in the policy declaration of the Federal Water Pollution Act of 1948.

> It is hereby declared to be a policy of Congress to recognize, preserve, and protect the primary responsibilities and rights of the States in controlling water pollution.[14]

This limitation on the federal jurisdiction was almost entirely self-imposed.[15] Its justification lay in part in a continued respect for the concept of federalism, and in part in a judgment, probably accurate in 1948, that some form of local control was a more effective means of combating water pollution than federal controls. Consequently, under early water pollution and air pollution control acts the federal function was to operate in full cooperation with state and interstate agencies and with local and municipal governments.[6] When pollution problems worsened rapidly, the wisdom of this secondary federal role was questioned.[7] The result, a new direction of the federal effort, is reflected in the declaration of policy of the Water Quality Control Act of 1965:

> The purpose of this act is to enhance the quality and value of our water resources and to establish a national policy for the prevention, control and abatement of water pollution.[18]

Though the concept of a partnership with the states still remains,[9] the unmistakable trend of federal programs has been to locate the responsibility for final decisions on water quality objectives, standards and priorities in Washington.[10]

## Air Pollution Control

In 1955 the Congress enacted the first federal air pollution legislation. The law was entitled "Air Pollution Control--Research and Technical Assistance."[11] It provided grants-in-aid for state and local air pollution control agencies for research, training and demonstration projects, and gave authority for technical advice and assistance from the federal government. It also authorized the Surgeon General to collect and publish air pollution information. The limited view of the federal role in the 1955 Act is reflected in the Senate Report on the legislation:

> The committee recognized that it is primarily the responsibility of state and local governments to prevent air pollution. The bill does not propose any exercise of police power by the federal government and no provision in it invades the sovereignty of states, counties or cities. There is no attempt to impose standards of purity.[12]

Some eight years later, in the Clean Air Act of 1963, the legislative finding still paid ritual obeisance to the doctrine of primary state responsibility for air pollution control.[13] The Act itself, however, indicated that a major change had taken place in the federal role and in the pattern of federal-state-local relations. It gave the U.S. Public Health Service a far broader role in handling air pollution problems and recognized the need for regional cooperation. While under the 1955 Act grants-in-aid had gone directly from the federal government to the cities, under the 1963 Act the state became the focal point. In addition to grants-in-aid and provisions for research and technical assistance, the Secretary of HEW was authorized to publish non-mandatory air criteria and to encourage and report on efforts to prevent motor vehicle exhaust pollution. Grants-in-aid were also provided for air pollution control programs and, perhaps more significant from the point of view of direct federal regulatory involvement, the law authorized the Secretary of HEW to intervene when air pollution was alleged to endanger "health or welfare," when any state was unable to cope with the problem by itself.[14] The precise nature of these regulatory controls, which have been continued under present federal legislation, will be discussed at greater length in another context.[15] As will presently appear, the 1963 Act, in providing for grants-in-aid to the states for air pollution control, exerted an enormous influence in the development and enactment of the states' own air pollution control legislation.[16] Moreover, the 1963 Act, departing considerably from the notion of strictly local control of air pollution, gave recognition to the need for regional planning and provided tangible incentives for regional cooperation in its grants-in-aid program--a larger proportion of the costs of establishing, developing and improving air pollution programs was to be reimbursed by the federal government if the grantee agency was an intermunicipal or interstate agency than if it served only a single city or other governmental unit.[17]

The 1965 amendments to the Clean Air Act moved even more toward direct federal involvement. They authorized the Secretary of HEW to promulgate and enforce federal emission standards for new motor vehicles, without providing for the participation in the standard setting process by the states or localities.[18] This was one of the early instances of clear reliance on the commerce clause as a basis for federal air pollution control. Based on similar constitutional authority, the 1965 amendments enabled the Secretary to act on pollution complaints brought by international agencies or by the Secretary of State. Such action included the ultimate right to bring suit against the polluter.[19]

The Air Quality Act of 1967 brought the federal government squarely into the field of air pollution control. While continuing the provisions of the earlier Clean Air Act for grants-in-aid for research and for other program activities by air pollution control agencies, for the first time the Secretary of HEW was not only authorized but charged with the duty of issuing air quality criteria.[20] The Act specifically required him to designate broad atmospheric areas, and to specify air quality control regions or parts of regions within the state's boundaries. If a state failed to adopt standards of its own, the Secretary was authorized to promulgate standards for the state, following a conference with the appropriate state officials. If requested by the state, a hearing was required before such standards could be promulgated. Moreover, if the state failed to enforce its own standards or failed to enforce the standards set for it by the Secretary, he was authorized to request the Attorney General to commence lawsuits for their enforcement whenever interstate air pollution was involved.[21]

A further change in the direction of greater federal involvement in environmental controls was evidenced by a new power granted by the 1967 Act. The Secretary of HEW was authorized to request the Attorney General to bring an abatement action in any air pollution situation which presented an imminent and substantial danger to health, without the necessity of a prior conference or hearing.[22] Moreover, the Secretary was granted exclusive authority to establish and improve emission standards for new motor vehicles, except in those instances in which a state had adopted a higher standard for new motor vehicles prior to March 30, 1966.[23] In fact, the exception applied only to the State of California, which had adopted such standards.[24] The Secretary was authorized, too, to study the feasibility of national emission standards, and was granted the power to require the registration of fuel additives.[25] In 1970 the function of the Secretary under the 1963, 1965 and 1967 Acts were transferred to the Administrator of the Environmental Protection Agency.[26] At present, in 1970, legislation is pending in Congress to authorize national emission standards.[27]

It is perhaps noteworthy that the 1967 Air Quality Standards Act not only placed greater emphasis on federal regulatory controls but also deemphasized local controls to a considerable extent. The initial burden for setting standards and for adopting plans for their implementation to meet regional air quality standards is placed on the states, after an appropriate public hearing. There is, moreover, no requirement that the local governments participate in such hearings.[28] The shift from a local to a broader regional, if not national, emphasis was reflected, too, in a number of federal incentives to regional cooperation. To be sure, the encouragement of regional cooperation--and especially the encouragement of interstate compacts--is not exactly unambiguous. While encouraging interstate compacts for air pollution control, the Act expressed the Congressional intention to disapprove any interstate compact which included states not within a federally determined air quality region.[29] This limitation, as will presently appear, aborted three air pollution control compacts on the verge of adoption.[30] However, though the federal attitude towards interstate and regional cooperation is not as liberal as appears on the surface, the Air Quality Standards Act does provide for more substantial financing of air pollution control programs in interstate regions than in intrastate regions, and seeks to stimulate the establishment of air quality standards in interstate air quality regions by paying up to 100 percent of the costs of planning such interstate programs for the first two years and, thereafter, authorizing the payment of up to three-quarters of the expenses of such a program.[31] There is authority also for the Secretary to establish a federal air planning commission for consultation with the respective governors if the states fail to establish interstate air quality planning regions.[32]

The federal role in air pollution control with respect to policy making and standard setting is thus one of limited but increasingly direct involvement. For the present, the federal government merely designates air quality regions and issues air quality criteria which, in a sense, are performance standards. It is up to the states to work out emission standards and plans for their enforcement so as to meet the federal air quality criteria, the performance standard nationally established for designated air quality regions. Though the federal involvement in setting emission standards for automotive pollution is somewhat more direct, this direct involvement in the policing of standards is thus far limited to new cars, the specific area where the federal government has the means of regulation at the source. The imposition of federal standards for emissions generally is as yet in the future. Though the federal government prescribes standards for air quality generally, it is left to the states--and to the localities--to establish the emission standards which industry and others must observe and which the air pollution control personnel must enforce.

## Federal Environmental Regulation--In General.

It is evident from the brief survey of the role of the federal government in setting standards and in making regulations for environmental control that most areas have developed along similar lines. Since most aspects of environmental pollution initially appear as subjects appropriate for regulation under the states' police power, the federal interest initially has been to bolster the exercise of the states' and the localities' power through grants-in-aid, grants for research and development, and grants for intergovernmental cooperation in dealing with environmental pollution. As it has become apparent in area after area that environmental problems are not easily susceptible to state or local resolution, but are indeed of regional or national scope, the federal interest has been enlarged and the federal government has taken on more and more of the burden of standard setting and regulation. As will presently appear, standard setting and regulation have not necessarily brought about a more direct federal involvement in enforcement activities for, on the whole, the federal government has traditionally sought to work through state and local instrumentalities in the control of the environment. It is also clear that federal standards--whether direct regulatory standards as in the case of radiation pollution or automotive emission standards, or indirect regulation through the use of the grant-in-aid device--have had an enormously stimulating effect on the states' and localities' own standard setting and rule-making endeavors. Since the passage of the Air Quality Control Act of 1967, when the federal government first set motor vehicle emission standards, for instance, some 28 states have enacted legislation to deal with vehicle pollution.[33] It is evident, too, that many of the state regulations for water pollution control were passed in response to federal grants conditioned on the states' enforcing appropriate standards, as provided in the 1965 Water Pollution Control Act.[34]

Another aspect of federal involvement in environmental controls needs to be mentioned. Until very recently, with the passage of the Environmental Policy Act of 1969,[35] the federal concern for the regulation of environmental pollution has proceeded on a totally piecemeal basis, with each environmental problem being taken up in turn, often without regard to its impact on other aspects of environmental quality. Aside from regulatory controls in the area of air pollution, water pollution, noise pollution, etc., the federal government's own involvement in programs that have significant environmental impact, such as highway, airport and research development activities, has proceeded separate from, and without regard to, the policies implicit in some of the regulatory efforts. The lack of coordination between regulatory programs on the one hand and the broad developmental programs on the other raises a significant question relating to the consistency of federal environmental policy. Unless federal programs with broad environmental implications can be reconciled with federal regulatory efforts in the control of the environment, no sustained coherent federal environmental policy will emerge.

## THE ROLE OF THE STATES AND MUNICIPALITIES IN STANDARD-SETTING

The states and localities have dealt with environmental problems under the states' police power practically from the beginning of time. Much of what is presently referred to as environmental legislation finds its origin in rather primitive early regulations promulgated in the state or local sanitary code as part of the regulation of the public health. So, for instance, the origins of air pollution control can be traced back to early colonial legislation and to even earlier English regulations that dealt with smoking chimneys and the nuisance created by smoke, fly ash and cinders.[36] The origins of water pollution controls may also be found in the early local regulations which prohibited a man from placing his cesspool too close to his own or his neighbor's well.[37] Frequently, such regulations preceded even the scientific knowledge which would have justified them, for the placement of a well near a cesspool was regarded as dangerous even prior to the knowledge that insufficient filtration could cause contamination of the well from the cesspool. So, too, local regulation of noise nuisances antedates by many years the clear evidence that excessive noise results in hearing loss. Thus, there has never been any real question that the states or the municipalities, by delegation from the states, had the power to enact laws or regulations that protect the health, safety and welfare of the people against adverse effects of environmental pollution.

## Air Pollution Control.

It is of course a long way from a local smoke ordinance to a sophisticated state or municipal air pollution control code. Generally the states and localities developed such codes in response to federal grant-in-aid programs that made it desirable for them to do so. So, for instance, following the initial federal air pollution legislation in 1955 which provided funds for research and development, the Council of State Governments first called the states' attention to the need for air pollution regulations and proposed some general standards through appropriate recommendations of one of its governors' conferences.[38] Today, almost all states have enacted state air pollution control legislation, some of the most recent enactments having occurred in response to the 1967 Federal Air Quality Act.[39] Typically the state laws designate a state agency or establish a new commission to promulgate standards and codes.[40] In most states the enforcing agency is the state health department,[41] although in some states separate air pollution control agencies have been created.[42] Most of the state laws allow local governments to enact air pollution codes or regulations of their own, but do not generally require it. A number require the state agency, board or commission to encourage local units of government to handle air pollution programs and to provide them with technical advice and assistance.[43] Under most state laws local units of government are empowered to enact laws or ordinances regulating air pollution, but the standards set by such local units must be consistent with, or more stringent than, the state regulations. A few states have even more detailed provisions to insure a coordinated state-local effort. In Florida, for instance, the state agency must review local standards before they become effective;[44] in Colorado the law requires a mutual review--local units must review state regulations and the state agency must review the local regulations before either becomes effective.[45] In some states, county and other governmental units are given the authority to study and investigate pesticide problems and to report them to the central air pollution control agency for review and action.[46] A few states, too, require municipalities and other local governments to participate in area-wide regulation, or else to become subject to direct state regulation.[47] Regional cooperation is authorized and provided for in many states' air pollution control laws, though none of them expressly require it.[48]

A recent draft of model state air pollution control legislation proposed by the Council of State Governments[49] requires local regulatory action by state law in a direct and effective fashion. Section 14 of the proposed law requires municipalities to establish and administer air pollution control programs. Local standards must be stricter than, or at least consistent with, those of the state and must provide for administrative and judicial sanctions. Moreover, the state agency is required to approve the program. If the local unit of government does not act, or if it does not carry out its responsibilities adequately, the state may, after a hearing, administer the program directly, and may charge the local unit for the expense. Interlocal cooperation is provided for, and the state agency may require area-wide air pollution control programs where considered necessary. If the local units of government do not cooperate in the establishment or administration of such a regional program, the state is authorized to administer the program directly. Finally, if the state agency determines that a particular class of air pollutants is more amenable to state regulation than local regulation, the state may assume exclusive jurisdiction.

The proposed model state air pollution control act is significant in that it deals with a number of problems that have arisen in state air pollution control programs and that existing legislation has failed to address. Generally, state and local air pollution control programs are structurally independent of one another. While the state theoretically exercises supervisory control over local programs, in fact there is considerable disjunctiveness both on the standard setting and on the enforcement level. The state generally exercises little or no supervision over the standards promulgated by local air pollution control agencies and the question of inconsistency between state and local standards is not likely to be raised at all unless a person charged with violating the local code raises the issue in defense to a criminal prosecution or other enforcement action. The disjunctiveness of state and local air pollution control programs within a single state is even more sharply pronounced in the area of enforcement and will be referred to in greater detail in that context.[50]

Originally, one of the most troublesome aspects of state and local air pollution control programs was the composition of the air pollution control agency empowered to set standards and make regulations. Normally state and local air pollution control agencies operate on well-established administrative law principles. The agency is established by law and is given power to promulgate an air pollution control code consisting of emission standards and such other standards as the enabling legislation may refer to in a general fashion. The enabling legislation normally prescribes the membership of the commission or board that is empowered to promulgate the code or other standards under the law.[51] It has been the practice in air pollution control legislation to give substantial representation to the very industries that were the most serious polluters. For many years, membership in standard setting boards in many of the states was based on something of a tripartite formula, with industry having approximately one-third of the seats and with the public, labor groups, and professionals with specific knowledge or interest in air pollution technology holding the other two-thirds.[52] Most of the professionals who were likely to be knowledgeable in air pollution control matters, however, were either employed by industry or were closely identified with industry's point of view. Consequently, many states' air pollution control agencies were for a long time industry-protection oriented, and would not recommend air pollution control measures that were costly or otherwise objectionable to industrial polluters. Moreover, state air pollution control legislation often contained safeguards from the very beginning that were protective of industry.[53] Provisions that require the agency to set air pollution control standards, taking into account "economic feasibility," were especially likely to result in standards that permitted economic factors to outweigh the claims of public health.[54]

State and local air pollution codes differ widely with respect to coverage and technical sophistication. On the most primitive level, all of them deal with visible emissions and set limits (usually in terms of the Ringelman chart) in terms of the density of emissions.[55] Most codes go beyond this primitive smoke-emission standard and deal also with gaseous emissions, whether visible or not.[56] On a yet higher level stand the codes that relate the amount of emission to the amount of heat produced by the apparatus--in effect, requiring minimal standards of heating efficiency.[57] Other, more advanced regulatory approaches limit certain harmful particulate emissions, including process dust, often relating the amount of permissible emissions to the weight of the bulk involved in the manufacturing process.[58] More advanced codes, moreover, impose not merely emissions standards, but also fuel standards, reflecting an appreciation of the fact that the nature of the emission is directly related to the nature of the fuel.[59] Finally, the most advanced codes provide for a system of permits and licenses both for the construction of factories, power plants, or other pollution producing installations, and for their operation.[60] The considerable variety in the nature of air pollution control codes is significant because the more sophisticated the code, the more complex the monitoring system, and the more highly trained the personnel required for its enforcement. Particularly in smaller municipalities, the means for the enforcement of a sophisticated code are not likely to be available. In consequence, there are serious limits on the capacity of a local air pollution control agency, for instance, to enforce a highly technical and sophisticated state air pollution control code.

## Water Pollution Control.

The history and development of state and local controls in the area of water pollution is again not too dissimilar from that in the area of air pollution. As in the case of air pollution, water pollution control by states and localities is based firmly on the police power.[61] Initially the individual had no realistic protection against water pollution beyond the possibility of a suit for damages and injunction against an upstream polluter.[62] And even private litigation suffered from the absence of any generally accepted standards of water purity against which to measure the degree of pollution.

Initial steps towards governmental control of water pollution came in the form of measures to protect domestic drinking water supplies[63]--as for instance, the sanitary regulation, previously referred to, that prohibited the placing of one's cesspool too close to one's neighbor's well. Other measures of similar nature took the form of statutes that made the dumping of offal and refuse into the waters a criminal offense.[64] Municipalities were often granted extraterritorial powers to abate pollution contaminating municipal water supplies,[65] and local boards of health were empowered to monitor the quality of water used for domestic purposes.[66] Frequently, however, local success in keeping water supply pure was often achieved by sending wastes downstream, thereby harming other localities.[67]

As pollution became more severe and its threat to the public interest became more apparent, the need for comprehensive state action was realized. In this second evolutionary step, several state agencies were typically given pollution control authority in their respective spheres of operation.[68] Where a single agency was assigned primary responsibility it was usually the state health department.[69] This assignment reflected the public concern of the times which focused almost exclusively upon the public health aspects of water pollution. Hines summarizes the main faults of this period as being (1) inadequate statutory authority, (2) lack of forceful administration, (3) inappropriateness of the public health dominion, and (4) lack of centralized authority.[70] These shortcomings became apparent whenever concerted action was required.[71]

The present practice is to create a single state agency and to assign to it the authority to make the major policy decisions relating to all aspects of water quality control.[72] In many states a number of agencies with lesser jurisdiction antedated the creation of the single dominant state agency. Many states, therefore, were faced with the choice of either creating an entirely new agency to assume jurisdiction from all existing ones, of creating a special statutory coordinating board or commission, or of singling out one of the existing agencies and granting it dominant powers over all other water pollution control agencies in the state. An example of the first type of agency is the Texas Water Quality Board. Directed by law to "set water quality standards for the waters in the state...,"[73] it in effect has achieved major master planning functions in the water areas for the state as a whole. The board is composed of seven members, of whom three are appointed by the governor and confirmed by the Senate; the four others are the chief executives of the Texas Water Development Board, the health department, the Parks Department and the Railroad Commission.[74] Generally, the appointed members are community leaders.[75] An executive director, who is full-time, operates as liaison for the part-time board members and supervises the execution of policies through an appointed staff.[76] Florida, which had initially entrusted water pollution control powers to the Department of Health, ended up by creating the Florida Air and Water Pollution Control Committee, composed of the governor, the secretary of state, the commissioner of agriculture, and two additional members appointed by the governor and confirmed by the senate.[77] Provision is made for a director with qualifications in bio-environmental or sanitary engineering.[78]

The coordinating committee approach is exemplified by Oklahoma. There the department of pollution control, created in 1968, consists solely of the pollution control coordinating board and of any special task forces that might be assigned to the department.[79] The pollution control coordinating board consists of the chief administrators of the five enforcement agencies--the Oklahoma Water Resources Board, the corporation commission, the state department of health, the state department of agriculture and the state department of wildlife conservation. The board's primary function is to coordinate the efforts of the various agencies in order to avoid duplication of effort and to promote efficient pollution abatement. The board was granted authority to prescribe water quality criteria, standards of water quality and the beneficial uses of the state's waters.[80]

The third approach of vesting control powers in existing agencies was adopted in New York. The New York Public Health Law gave the water resources commission the power to classify waters and to adopt standards. The enforcement of the program, however, was delegated to the State Department of Health. The Water Resources Commission, though it promulgated classifications and standards for the Department of Health to enforce, was an independent body nominally within the structure of the Conservation Department.[81] In April, 1970, New York abandoned this structure, transferring the functions of the Water Resources Commission and the Conservation Department to a newly created Department of Environmental Conservation which has general standard-setting and enforcement authority in environmental matters.[82]

A number of state water pollution control efforts have been criticized on structural grounds--it is said that separating standard setting and rule making powers from enforcement powers has proved unsatisfactory. According to this view, the coordinating committee would seem likely to be the least effective form of agency since by definition it has coordinating powers only and may not enforce directly. Conversely, a centralized agency, such as that of Texas, with its own staff and extensive enforcement authority, is likely to be far more effective. It has been charged, for instance, that the reason for the lack of effectiveness of the old New York law was the absence of close coordination and cooperation between the Water Resources Commission, the policy maker, and the Department of Health, the enforcement agency.[83] The implications of separating standard setting and rule making from enforcement responsibilities ought to be taken into account when considering the recent trend towards the establishment of coordinating and standard setting agencies for environmental controls at large. There is evidence that the establishment of coordinating agencies, or the separation of policy making from enforcement activities is of dubious effectiveness even within any one field of pollution control, such as water or air pollution. Why, then, should there be greater effectiveness expected of a state-wide pollution control agency with responsibility for policy-making in water pollution, air pollution, noise pollution, solid waste disposal and all the rest, but leaving enforcement responsibilites to specific divisions within the overall pollution control agency? That is not to say, however, that interagency coordination is not both desirable and necessary. It is true, for instance, that water pollution problems cut across many lines of interest and require many different kinds of technical knowledge.[84] Even a unified water pollution control department may find it difficult to administer its program if it does not take cognizance of the expertise and interests of other agencies.

The composition of water pollution control boards differs from state to state but, just as in the case of air pollution control boards, follows a number of set patterns. When a board's function is primarily advisory, the representation of interests on the board is likely to be very broad,[85] although some advisory boards consist wholly of officials of state agencies involved in various aspects of water pollution control, serving on the board *ex officio*.[86] In many instances advisory boards or boards charged with standard setting functions consist of officials of enforcement agencies and of persons representing interests most directly concerned with the regulation of pollution.[87] Ordinarily, when a water pollution control body has not only supervisory or standard setting authority but also exercises enforcement functions, it is likely to be composed primarily of agency officials.[88] The question of whether or not it is desirable to include members of the regulated industry on a standard setting or rule making body has been previously referred to in the context of air pollution regulation. It has been suggested in the context of water pollution control that the members of the regulated industry, who are likely to be the major contributors to the pollution that is sought to be regulated, should not be given an official position in the standard setting agency because their views have usually been adequately represented in the legislature in the course of legislative hearings, and by counsel in board hearings on proposed regulations. It is likely that in water pollution standard setting agencies, just as in air pollution standard setting agencies, the presence of industry board members has hindered the regulatory effort by at least as much as it has advanced it.[89]

State agencies differ considerably with respect to their jurisdictional scope, and this of course has considerable implications for the kinds of standards and the reach of the regulations that they may impose. Some state statutes limit agency jurisdiction by giving it regulatory control only over specified waters, or by exempting certain waters from regulation.[90] Other states exempt ground water pollution thereby ignoring the integral relation between the quality of ground waters and surface waters.[91] The more up-to-date and comprehensive statutes generally and expressly include *all* waters within the pollution control effort.[92] The presence of certain political and economic pressures is clearly visible on the face of certain of the water pollution control statutes. Thus, for example, Pennsylvania makes its act applicable only to sewage and exempts from coverage all wastes from coal mines, tannery and municipal sewage systems existing at the time the act was passed.[93] Sometimes, too, the regulatory scope of the law is limited by a very narrow definition of the wastes capable of creating a condition of pollution.[94] It is clear that inclusive coverage is not difficult to achieve statutorily through a broad grant of jurisdiction and a liberal definition of activities to be regulated.[95]

State agencies' powers differ considerably with respect to the kind of water quality standards they may impose. Though on their face modern state water pollution control laws grant broad powers to the control agency,[96] not all of them grant full powers to the agency to set water quality standards across the board. Many states that have the power to establish water quality standards are approaching the task in gradual stages. Some states have never gotten beyond the promulgation of broad minimal standards, while other states have not set statewide standards but have proceeded area by area.[97]

The New York law and the regulations promulgated under it offer a good example of a comprehensive program of water classification and the adoption of quality standards. The waters are classified on a "best use" basis, which means that the existing or potential use requiring the highest degree of purity is used to set the standard.[98] Public hearings are required in the standard setting process. Standards of purity are assigned to the various rivers and streams based on the following criteria:

1. Stream characteristics, including size, temperature, and drainage area;
2. Character and use of the surrounding area;
3. Existing and potential uses of the stream; and
4. The extent of present defilement or pollution.[99]

In order to avoid standards from becoming permanently fixed at too low a level of quality, the New York Water Resources Commission had the power to repeal, modify, or alter standards from time to time. The water classification program in New York has been attacked as an unconstitutional delegation of legislative authority. The constitutionality of the law and the regulations were upheld, however, by the highest court of the state.[100] Similar water classification schemes have been upheld in other states against constitutional attacks based not only on improper delegation but also on due process and equal protection grounds.[101]

Where a state's water pollution regulations have been adopted, there is relatively less scope for rule making on the local level, except insofar as such local regulatory efforts may be expressly sanctioned or authorized by state law. In the main, however, the local regulatory effort is likely to support the state effort by assisting the municipality in meeting the requirements imposed on it by state law. This happens to be one of the unusual areas of the law in which local governments have been sued by state water pollution control agencies to compel compliance with state regulations. This is particularly true in instances where the locality has failed to provide adequate sewage treatment facilities to treat raw sewage before it is discharged into one of the state's waterways.[102]

In many localities local subdivision regulations require developers of entire subdivisions or developers of sizeable tracts to provide for community disposal systems and for community-operated treatment plants instead of individual septic tanks.[103] The aim is to help meet the state's water purity standards. In many jurisdictions, developers may not proceed with building operations until the local agency has been assured--by way of submission of plans for certification--of the developer's intention to make adequate provision for sewage treatment in his development.[104]

In water pollution control there has been far closer correlation between state and local agencies than in air pollution control. The reason probably lies in the different character of water and air pollution. In the case of water pollution the problem is generally well defined by a river bed which touches many municipalities within the state. Consequently, the failure to conform on the part of one municipal agency becomes immediately apparent not only to the state agency but to all other municipal agencies downstream. The problem of air pollution is far less well defined because air pollution, though it may move with prevailing winds, does not move in clearly defined channels, and the contribution of any one municipality to the total amount of air pollution in a region is not only difficult to gauge but also difficult to prevent. Consequently, disjunctiveness of effort in the air pollution control field is less likely to become immediately apparent than would be a similar disjunctiveness of effort in water pollution control.

## Solid Waste Disposal.

Other areas of environmental control, such as solid waste disposal and noise control are by their nature far more local in character, and in each instance the federal concern is thus far reflected primarily in grants-in-aid legislation for research and development and, to a far more limited degree, in federal regulations.[105] Solid waste disposal has been handled thus far by local regulation, generally subject to state enabling legislation.[106] The manner in which solid waste is to be collected, the manner in which the householder is to store his solid waste and get it ready for collection is generally treated in state or local sanitary, health,[107] or housing codes.[108] The subsequent disposition of wastes collected by municipal sanitation departments or by private garbage collectors is also regulated by local ordinances, subject again in most instances to state enabling legislation.[109] Thus the proper method for sanitary landfills and the required quantity of clean soil to bury waste are regulated by state or local health codes.[110] The manner in which wastes may be incinerated, either in a municipal incinerator or in a privately operated incinerator, or by burning on the lot, is generally subject to state or local air pollution control regulations.[111] What is noteworthy in this context is the fact that the relationship of solid waste management to air pollution control or to water pollution control is not articulated in any state law or regulation--in spite of the fact that some jurisdictions have had that connection brought to their attention--rather forcefully--as in New York, where an order to shut down apartment house incinerators led to a garbage removal crisis.[112]

The statutory treatment of solid waste disposal is also interesting, in that it appears to be concerned to a far greater extent with the economic rather than the environmental aspects of the problem. Provisions for the issuance of bonds for incinerators and other disposal systems abound, and special districts for this purpose are sometimes authorized.[113] In large cities, considerably more attention is devoted to the licensure of private garbage collectors--a sometimes racket-ridden industry--than to the sanitary aspects of waste collection and movement.

On the whole, state laws relating to solid waste disposal exist in their own statutory compartment just as does water pollution and air pollution control legislation.[114] While some states are beginning to reflect the recognition of the interrelationship of different aspects of environmental pollution through the establishment of coordinating committees and agencies of various kinds, no effective means appears to have been found as yet to reflect the close interrelationship of these matters in operative regulations.

## Noise Pollution Control

The subject of noise regulation is in some respects unique; though there has been some recent federal development in the area,[115] the states and the municipalities have on the whole dealt with quite distinct aspects of it. State regulation of noise is essentially limited to muffler legislation intended to reduce noise produced by motor vehicles,[116] and to regulations relating to industrial noise for the protection of workmen.[117] Aside from these two separate areas, the regulation of noise has been largely a local responsibility, and the local regulation involved has been of a rather minor kind, namely the establishment of miscellaneous prohibitions collected in local codes under some such heading as "police ordinances." Usually these are composed of matters too trivial to appear in the state's general code, and they generally concern matters too neglected in modern times to be included in public health law or the like.

The fact that the states have generally not legislated against noise and that such local laws as exist are largely recompilations of old ordinances, suggests that very little attention is presently being paid to the problem and that there is little expectation that the local laws will be actively enforced. This point is substantiated by looking at the anti-noise laws in a few American cities. In New York City, the relevant provision of the Administrative Code prohibits "the creation of any unreasonably loud, disturbing, or unnecessary noise" or of "noise of such character, intensity and duration as to be detrimental to the life or health of any individual."[118] This is followed by a list of specific acts that "among others" shall be deemed to be violations of the general prohibition. Some of these themselves are phrased in terms of "loud" or "unnecessary" or "disturbing" noises of various kinds. Included, too, are such concrete examples as horn blowing, except as a danger signal, failure to use a muffler, and construction work between 7 p.m. and 6 a.m. on weekdays except by special permit. Other provisions regulate sound trucks and other amplifying devices used in public.[119] Philadelphia's code of ordinances prohibits unnecessary noise in the handling of trash cans, and construction work between 6 p.m. and 6 a.m. It also contains special provisions to protect the quiet of hospitals, churches, court houses and schools, and prohibits the use of outdoor amplifying devices for advertising purposes, unnecessary horn blowing and "all other loud and unnecessary noises upon or near to the streets or other public places in the city," and provides for the regulation of street peddlers.[120] Chicago, in addition to some of the more standard provisions, provides that "rails, chimneys, and columns of iron, steel, and other metal which are being transported on the public ways of the city" shall be loaded so as to avoid the creation of loud noises.[121]

What all of these city ordinances lack is a coherent scheme of noise control. Typically they are collections of specific prohibitions drafted and enacted from time to time by the local legislative body in response to some special problem, and not subject to revision, review and updating by an administrative agency having the requisite expertise to deal with noise problems in a consistent fashion. There are, however, some notable improvements on the horizon. Modern zoning ordinances, especially the 1960 New York City Zoning Resolution, deal with industrial noise and similar environmental insults, such as vibrations, not only by the ordinary zoning technique of requiring separation of incompatible uses, but also by imposing specific performance standards for the more frequent pollutants. Thus decibel standards for particular zones are imposed to set permissible standards for noise, just as standards for vibrations, smoke, dust and other particulate air pollutants, odor, toxic emissions, fire and explosive hazards and other onerous environmental hazards are dealt with in relation to the use of particular zones for designated purposes.[122] A modern zoning ordinance also can, and should, deal effectively with the problem of effective airport zoning. Certain facilities--such as schools or hospitals--should be excluded from neighboring zones unless properly sound-proofed. Imaginative use of the zoning power can protect the airport without placing a complete bar on other development in the area.

At least two building codes, in New York[123] and in New Jersey,[124] require sound insulation in new buildings as a condition of a building permit or a certificate of occupancy. In addition to requiring adequate sound insulation against noise from outside the building or from other parts of the building, these codes also provide for adequate protection against noise sources from within the building itself--i.e., ventilation and heating equipment, elevators, ducts and other machinery and facilities.

Unlike earlier municipal noise regulations which were enacted from time to time by municipal legislatures, these newer regulatory efforts are not only more comprehensive but are also the result of technical work done by knowledgeable and technically qualified administrative agencies with special competence in the field.

## THE ROLE OF THE FEDERAL GOVERNMENT IN THE ENFORCEMENT AND ADMINISTRATION OF ENVIRONMENTAL REGULATIONS

While there has been a gradual move towards the consolidation of standard setting responsibilities at higher levels of government, the major responsibility for seeing that air pollution, water pollution and other environmental standards are actually enforced rests at the lower level of the governmental hierarchy.[125] In part, the fact that the responsibility for enforcement activities is not centered at the federal level reflects the earlier assumption that environmental controls are primarily a local responsibility. In part, too, the primary emphasis on enforcement powers at the local or state level reflects the realistic appreciation that there is local and state enforcement machinery--i.e., a staff of inspectors and force of clerical back-up personnel--while there are very few federal enforcement officials who are concerned with matters of day-to-day enforcement against individual violators of the standards, rules and regulations.

The consequence of a predominantly local emphasis in enforcement is that in air pollution and water pollution control, as well as in any number of other areas of environmental protection, federal enforcement against persons who violate standards is not only infrequent but is viewed as a rather extraordinary measure.

As constituted in 1970, federal law provides for federal abatement procedures in four separate situations. If solely intrastate air pollution is involved, the Administrator of the EPA may take action only if requested by the governor of the affected state. But he may not proceed if he determines that the effect of such pollution is not of such significance as to warrant the exercise of federal jurisdiction.[126]

A second procedure, added in 1967, authorizes the Administrator to seek immediate court action to stop emission of pollutants where there is evidence of "imminent and substantial endangerment to the health of persons" and where state or local authorities have failed to act.[127] The section is intended as a remedy for emergency situations only, and the Congressional intent embodied in the House Report that accompanied the legislation was clearly to make the remedy inapplicable as a continuing control for chronic or generally recurring problems of less than calamitous nature.[128] Local authorities do not have the power to require the Administrator to act under this section. The Congressional intent regarding the section was clearly to have it used only in such extraordinary situations.

A third procedure is provided for if the interstate air pollution occurs in an air quality control region with established air quality standards.[129] Federal enforcement is authorized only if the Secretary finds that air quality has fallen below the prescribed standards, and that the state itself has failed to take reasonable action to implement and enforce the applicable standards.[130] While the Administrator may act on the basis of the complaint from one of the states affected, he is not required to act on the basis of such a state complaint, and it is up to him to determine whether the state complained of has or has not taken "reasonable action" to bring about abatement.

Finally, the fourth procedure which may bring the federal government into an active enforcement role is that which was initially provided by Section 105 of the

Clean Air Act of 1963. The procedure is applicable only in instances of interstate air pollution where the source of the pollution is in one state and the adverse effect in another. The Administrator is required to call a conference whenever requested to do so by the governor or by a state air pollution control agency of one of the states affected, or with their concurrence, by a municipality, if there is evidence of air pollution "which is alleged to endanger the health or welfare of persons in a state other than that in which the discharge originate (s)."[131] The Administrator is also free to call a conference on interstate air pollution on his own initiative after consultation with the officials of the affected states.[132] It is noteworthy that this is the only instance under the law in which a state or municipality can require the Administrator to act. However, an individual citizen cannot require him to act under this or any other federal enforcement provision.

When a conference is called by the Administrator, the interstate, state and local agencies involved participate in it, and an appointee of the Administrator presides. The person responsible for the discharge may be invited by one of the member agencies, but there is no legal requirement that he attend the conference, and it has been held that due process does not require his presence since the conference is neither rule-making nor adjudicative.[133] The conference meets on thirty days' notice accompanied by a preliminary report made by EPA. Advance notice is also given to the public by publication on at least three difference days in a newspaper of general circulation in the area.[134] The conference itself is informal and does not have the character of an administrative hearing.[135] Following the conference, EPA prepares and distributes a summary of the conference discussions, and the Administrator may recommend necessary remedial action. The law provides that the polluter must be allowed six months to take the remedial action recommended. If six months later the Administrator is dissatisfied with the progress made, he may call a formal public hearing before a hearing board of five or more persons appointed by him. Each of the states affected may choose one member, and each federal department which the Administrator determines has a special interest in the matter may choose one member. One member must be a representative of an appropriate interstate air pollution control agency, and a majority of the members must be persons other than officers or employees of EPA.[136] The appointment of a formal hearing boards is entirely at the discretion of the Administrator,[137] and the complaining state or municipality has no role in the initiation of this step. All interested persons must be given an opportunity to present evidence at the hearing, and the board makes recommendations for affirmative action to abate the pollution on the basis of the evidence presented. The findings and recommendations of the board are forwarded by the Administrator to the alleged violator and to the agencies involved, together with a notice specifying a reasonable time of not less than six months for compliance.[138] Neither the board nor the Administrator has been granted authority to issue a binding order following the hearing, and the Administrator is not authorized to impose any sanctions for the violator's failure to comply with the directives of the conference. It has been held that, though more formal in character, the hearing is not adjudicative and the alleged violator cannot obtain a judicial review at this stage for he has not as yet been subjected to any legally binding order.[139] If the alleged violator, however, fails to comply with the hearing board's directions within the time set for such compliance, the Administrator may then ask the Attorney General to file suit in the federal district court to secure abatement.[140] This is the first and only instance in the lengthy procedure that a sanction has been provided for failure to comply. However, the complaining state or municipality cannot require the Administrator to take this step. Whether or not the Administrator decides to ask the Attorney General to file suit is again left entirely to his own discretion. When suit is brought, the court may receive any transcript of the proceedings before the board and a copy of the board's recommendations, along with any other evidence which the court deems proper.[141] The board's findings and recommendations will not be received as evidence to prove any facts recounted in them, but will be evidence only as to what the public interest and the equities of the case may require. Both the government and the defendant have an opportunity to produce additional evidence.[142] The court considers all pertinent factual and legal issues de novo and in making its determination,

> The court, giving due consideration to the practicability of complying with such standards as may be applicable and to the physical and economic feasibility of securing abatement of any pollution proved, shall have jurisdiction to enter judgment, as the public interest and the equities of the case may require.[143]

Although this procedure has been available since the enactment of the Clean Air Act of 1963, its effectiveness has been minimal. It is most cumbersome and slow, and in the past seven years it has been invoked in only nine interstate areas.[144] In only one instance, moreover, has the case gone beyond the conference recommendation state, i.e., beyond the very first formal step. That case involved the Bishop Processing Company of Bishop, Maryland, which was charged with emitting such vile odors from its chicken offal processing plant as to endanger the health and welfare of persons in Selbyville, Delaware, two miles distant. In that case, administrative proceedings were initiated by a request from the Delaware State Air Pollution Authority which, with the state of Maryland, had been engaged in futile efforts since 1959 to induce Bishop to abate its pollution. A formal hearing was subsequently held in May of 1967 after the company had failed to make satisfactory abatement efforts. The company was directed, following the hearing, to abate the pollution by December, 1967. On July 28, 1968, some two and a half years after the proceedings had begun, the district court in Maryland denied the company's motion to dismiss the government's suit seeking abatement. In the fall of 1968 the Bishop Company agreed to a settlement requiring it to cease operations upon the filing of an affidavit by the Delaware Water and Air Resources Commission, stating that the company was causing air pollution in Delaware. The affidavit was not filed until March of 1969. In September an order was issued directing the company to cease operations. The order was, however, stayed during Bishop's appeals to the Court of Appeals and Supreme Court and did not become final until spring of 1970--five years after the inception of the federal procedure and eleven years after the state governments first became concerned with the situation.[145]

The range of federal enforcement powers under federal water pollution control legislation, as amended by the Clean Water Restoration Act of 1966, is similar to--and appears to have been copied from--that in the air pollution area. The bases for federal intervention, closely paralleling those in air pollution, are: (1) pollution of interstate and navigable waters in or adjacent to any state or states that endangers the health or welfare of any persons, (2) a governor's request for federal intervention when pollution in one state affects the health or welfare of persons in another, "unless the effect of such pollution on the legitimate uses of the waters ...is not of sufficient significance to warrant federal jurisdiction."[146] In addition, action may also be instituted when the Administrator of the EPA has reason to believe that pollution in interstate or navigable waters creates substantial economic injury resulting from inability to market shellfish or shellfish products in interstate commerce, and, finally, whenever the Administrator has reason to believe that pollution of interstate or navigable waters endangers the health or welfare of persons in a foreign country and the Secretary of State has requested him to abate such pollution.[147] The procedure consists of three stages. First, a conference with participation by state and interstate agencies and the alleged polluters, followed by recommendation by the Federal Water Pollution Control Administration to the state agency to take action within a period of not less than six months. Second, a formal hearing before a board appointed by the Administrator, and, after such hearing, again a direction that abatement measures be taken within a reasonable time of not less than six months. Finally, a discretionary request by the Administrator to the Attorney General to bring suit for an injunction on behalf of the United States.[148]. Some 43 informal conferences were held through 1968; only four continued to the hearing stage. Of these, only a single case was taken to court.[149] Another provision allows compliance action by the Attorney General upon 180 days' notice to the polluter; no court action has as yet been taken under it.[150]

Both in air and water pollution enforcement, the federal government relies primarily on informal negotiations rather than on hard enforcement, for it is clear that the established enforcement devices do not meet the need for the swift and decisive action that may be necessary. Hence federal enforcement under both the air and water pollution control acts is only as effective as informal procedures prior to court action can make it. This is well in line with long accepted principles of public health compliance techniques which rely primarily on education and on negotiated cooperative measures.[151] It is clear, however, that these measures are not designed to gain compliance from a hard-core violator who sees no immediate reason for prompt compliance when it is costly and burdensome. Under both the federal air and water pollution control acts such a violator knows that he has two to three years from the time when the federal government commences its laborious proceedings until he may actually be compelled to take abatement measures. There is virtually no incentive for him to take earlier action, because neither the Air Quality Standards Act nor the Clean water Restoration Act penalizes his delay--no fines or other sanctions are provided for dilatory action.

Federal regulations with respect to aircraft noise appear to be preemptive in intent.[152] While both the courts and the Federal Aviation Administration have asserted that operators of airports have the ultimate right to decide which aircraft can or cannot use their facilities as long as their judgment is not discriminatory, whatever decisional law there is seems to hold that local governments may not pass airport noise regulations or ordinances more stringent than the standards adopted by the FAA--though they may promulgate such standards in their proprietary capacity as airport operator.[153] Thus, although there has been considerable dissatisfaction with the federal aircraft noise standards,[154] municipalities have been severely handicapped in defending their inhabitants against excessive noise from aircraft in interstate commerce. The suggestion is readily at hand that preemptive federal standards, both for automotive emissions and aircraft noise, are as much designed to protect the particular industries affected against more stringent controls by the states and municipalities as they are to protect the public.[155] This point may gain in force in light of recent federal participation in the development of the supersonic transport plane, for the regulation of sonic booms, it seems, is also a federal monopoly under the same legislation that authorizes FAA regulation of aircraft noise.[156]

Difficulties created by partial federal preemption of a field are demonstrated too by the current state of the law with respect to the control of jet plane noise. The federal regulations set by FAA are preemptive in that no state or local government may set higher standards than the standards established by the federal agency.

On the other hand, the federal agency has repeatedly stated that its regulations provide a minimum requirement only and that the proprietors and operators of airports throughout the nation are free to set standards of their own-- i.e., each airport may decide that it will not permit its facilities to be used by planes that exceed a noise level set by that airport even though the level set by the airport itself may be higher than that set by FAA.[157] In actual fact the purported permission to airports to set standards of their own is wholly illusory because, as a practical matter, airport operators cannot enforce higher standards. In this instance the federal standard is entirely more preemptive than it purports to be. The assertion that it is not wholly preemptive serves the purpose of the federal regulatory agency, however, because whenever the federal standard comes under attack, the agency can respond that the local airport is free to require more stringent compliance if it wants to do so. Here, too, federal preemption has created a no-man's land in which there is federal abstention from standard-setting without any concomitant grant of power to the state or municipality to take up the slack.

## THE ROLES OF THE STATES AND MUNICIPALITIES IN THE ENFORCEMENT AND ADMINISTRATION OF ENVIRONMENTAL REGULATIONS

### AIR POLLUTION CONTROL

Regulations to control environmental pollution are generally enforced on the state or local level, if they are enforced at all. Whether particular enforcement efforts are the responsibility of a state agency or local agencies depends on the state's administrative or structural arrangements. In most states the agency primarily responsible for environmental controls is still the state health department.[158] State health departments differ from state to state with respect to the degree of centralization and the degree of their interrelation with local health agencies. In some states the department operates primarily as a standard setting or rule making agency which may have advisory and other "staff" functions for the state as a whole, but which takes little or no "line" responsibility for the activities of individual municipal or county health departments. In many instances the supervision by the state health agency of the activities of local or municipal health agencies is minimal indeed. The state health department does not supervise the day-to-day operations of local or municipal agencies, and may be called in only to take steps when some major failure on the part of municipal or local health agencies has occurred.[159] In other states the responsibility for enforcement of health laws and regulations is much more centralized in the state health department, with county and municipal health agencies directly responsible for their routine performance, and accountable to the state health agency for all of their programs.[160] In those instances a true "line" relationship exists between the local or municipal health agency and the state health department. A variety of more or less intermediate patterns exists, but in almost every instance the primary responsibility for standard setting and rule making is in the state health agency, and the actual enforcement function is lodged lower down in the hierarchy--whether or not the local agencies are directly responsible to the state agency or operate more or less independently from it.

The relationship of state health departments to county and municipal health departments is further affected by a variety of legal relationships dependent on the state constitution and on legislation that defines the relationship of counties and municipalities to the state generally. In many states, for instance, incorporated municipalities , such as villages and cities, will have health departments of their own, and in addition there will be a county health department which may or may not be an administrative branch of the state health department. This county health department will commonly have jurisdiction to operate within the unincorporated areas of the county, but each of the cities and villages will be free to regulate its own affairs, consistent, however, with whatever standards the state health agency may have prescribed for the state as a whole.[161] Moreover, the extent to which health departments in incorporated municipalities, such as villages and cities, may manage their own affairs may depend to a considerable extent on the degree of home rule granted to such municipalities, either by state constitution or general municipal legislation, or by their own individual charters. In terms of air pollution legislation, for instance this means that there is likely to be a statewide air pollution control code[162] to meet the requirements of the 1967 Air Quality Standards Act for the air quality regions federally determined for that state. This statewide air pollution control act and the state code adopted pursuant to it indubitably set the minimum standard for the entire state. These standards are probably the only standards applicable to the unincorporated areas within the state. Additional requirements may have been set by a county air pollution control agency, and these standards, though consistent with the state code, may be higher for the county as a whole.[163]. The county standards, depending on some of the factors previously mentioned, may apply to the entire county or merely to its unincorporated areas--or it may apply to all of the unincorporated areas in the county and to such of the incorporated areas, i.e., villages and cities, that have not adopted air pollution control codes of their own. Any major city, however, particularly if it has a substantial amount of industry, is likely to have an air pollution control code of its own which will have to be consistent with the county code, if any, and certainly with the state code. It may be more stringent than either one of them, particularly if it can be shown that the municipality has special problems of pollution caused by particular topographical or industrial features that are not shared by the rest of the county or state.[164]

The question raised by this array of overlapping, albeit supposedly consistent, codes is which agency enforces any one air pollution control code. As a rule of thumb it may be stated that each municipality or other jurisdictional entity enforces its own code, without much regard to the code of the next higher jurisdiction in the hierarchy.[165] Each municipal air pollution control agency has a staff of air pollution inspectors and some monitoring or other surveillance equipment of its own, and each of these staffs and their equipment are used for the purpose of cutting down on emissions from within the jurisdiction so as to accomplish compliance with that jurisdiction's code. None of the municipalities have extraterritorial powers, and in practice, each jurisdiction can abate only the emissions emanating from sources of pollution within its own borders.[166] Thus the air pollution inspector is stopped absolutely in his enforcement efforts by the local boundary line. If City A has the most advanced air pollution control code but receives most of its pollution from industrial sources in City B located within the same county, the air pollution control inspectors of City A cannot enter City B to serve a violation notice on the industrial pollution source in B. Only the air pollution control inspectors in City B can do so.[167] If the main consequence of emissions in B is pollution fallout in A, and if the source in B is a major employer of B's population, enforcement may not be overly zealous. There is also a question in many states whether the air pollution control inspector of the county in which both A and B are located can go into either of the cities to serve a violation notice because he, in turn, may be limited by provisions of law that grant enforcement powers within their own boundaries to incorporated municipalities. While air pollution is no respecter of jurisdictional boundaries, air pollution control agencies are, by reason of the law under which they operate. The consequence of jurisdictional limits on enforcement has frequently been to render helpless municipalities which themselves produce few emissions but which, by reason of topography or prevailing wind, receive all or most of the fallout from neighboring municipalities. There are even a number of instances on record when inventive owners of manufacturing establishments combined to incorporateindustrial enclaves as cities or villages, as a defensive measure against the imposition of pollution controls.[168] Thus a highly industrial area with a daytime working population of several thousand persons and a nighttime population limited to a few watchmen may effectively eliminate the possibility of having environmental pollution controls enforced against them. All of the surrounding residential communities may enact the most sophisticated air pollution control ordinances, but since the source of emissions is in another incorporated area, the residential community's air pollution control codes will have little effect, because its air pollution control agency has no jurisdiction to enter the incorporated industrial area for purposes of enforcement. The only possibility to secure adequate enforcement under such circumstances is to grant enforcement powers for county and state agencies even within the incorporated areas. In the past, however, enforcement staffs have been lodged at the local level and in many states where the structure of health departments depended on local enforcement efforts, there was no effective enforcement staff on the state or county level. These structural hindrances to effective environmental controls are not the result of willful obtuseness on the part of state or local officials. When the business of health departments consisted primarily of epidemiologic controls or of controls of food establishments, eating places, etc., the kind of division of labor between state, county and local departments involved here made good sense and was appropriate to the problems for which it was designed. It is only the realization that environmental problems have spread beyond narrow jurisdictional boundaries and affect incorporated and unincorporated areas alike that makes much of the traditional governmental machinery for public health enforcement archaic and inappropriate for the uses to which it must be put.

## WATER POLLUTION CONTROL

A somewhat different pattern of enforcement is encountered in the field of water pollution control. The municipalities generally are in charge of enforcing certain aspects of the purity of the water supply -- i.e., it is generally the municipality's job, either under appropraite health code regulations or under subdivision ordinances, to see to it that necessary septic tanks and private sewage disposal systems are built and that they are built in a manner that will prevent pollution of well water and other sources of water supply.[169] Normally non-compliance is punishable as a misdemeanor,[170] and usually the construction of a private sewage disposal system requires a permit from the local health agency with the frequent requirement that the system not be covered up or buried before a sanitary inspector has had an opportunity of checking it.[171] In addition, the municipality generally is in charge of enforcement against malfunctioning private sewage disposal system and usually has the power of summary abatement if these systems develop into nuisances.[172] The municipality may have a requirement, too, that as soon as public sewers become available, the householder is under an obligation to connect his own facilities to the public sewer, paying whatever special assessments there may be for that service.[173] In some instances, subdivision developers may be compelled by local law to provide community sewage treatment plants for the development as a whole.[174]

Aside from local enforcement of the nature previously mentioned, water pollution control is generally lodged at either the state level or the regional water basin level in those instances when the state relies on separate agencies for separate river systems rather than on a central water pollution control agency.[175] In either case, the agency may itself seek out violations of standards through inspections or through a monitoring system, or it may respond to complaints.[176] Most state laws require that a hearing be held whenever a probable violation is discovered and that the alleged violators be afforded an opportunity to appear and answer the charges.[177] Some state laws contain provisions for emergency procedures that allow the agency to dispense with hearing prior to issuing an order; under those circumstances a hearing must normally be held as soon as possible after the order has been issued.[178] Following the hearing, the usual remedy is the issuance of a cease and desist order.[179] In New York, for instance, the Commissioner may issue "such final order or make such final determinations as he deems appropriate under the circumstances.[180] Failure to comply with such an order may generally be penalized by both civil and criminal sanctions. Violations are usually treated as misdemeanors.[181] Civil penalties are recoverable separately by civil action. The range of penalties for failure to live up to water quality standards is rather wide from state to state, just as is the range of penalties for air pollution violations. In some states, the maximum fine may range only up to one or two hundred dollars per violation. In others it may go as high as $3,000. In Florida, for instance, the civil penalty is $1,000 for each offense, and the criminal penalty for a misdemeanor is a thousand dollar fine and a year in jail for each offense.[182] In New York the criminal penalty may include fines from five to twenty-five hundred dollars and imprisonment of up to one year for each offense.[183] In a number of states, each day of non-compliance may legally constitute a separate offense.[184] Most state statutes also provide for injunctive relief when violator has failed to comply with earlier agency orders.[185] All of the state laws provide for judicial appeal and for review of agency orders.[186] Generally such a review will be based on the record of the hearing before the agency,[187] although a minority of jurisdictions require a de novo review by the courts.[188]

Although enforcement procedures under state water pollution control acts are fairly similar throughout the country, enforcement in different states varies considerably in effectiveness.[189] The major reason for such differences appears to be the relative aggressiveness of the responsible agency.[190] Water pollution control is one of the few areas of enforcement in which a significant number of cases can be found where the state agency has actually sued a municipality to compel compliance by the local government with state standards relating to sewage treatment, water purity and permissible emissions.[191]

## SOLID WASTE DISPOSAL

With respect to solid waste disposal, enforcement is an entirely local matter. As has been pointed out previously, many states have extensive legislation dealing with the municipality's obligation to collect wastes and to dispose of them either by incineration or by sanitary landfill methods. Almost all municipalities have detailed regulations with respect to placement of wastes outside the home for collection and many of them go into significant detail with respect to the kind of containers that are permissible, where they may be placed and how soon they must be taken in after trash and other wastes have been picked up.[192] Violations of such laws and regulations are generally treated as minor misdemeanors, and the fines imposed are likely to be very low.[193] Sanitary landfills, however, may be subject to a system of licensure in some jurisdictions.[194]. A number of municipalities have enacted some special legislation or regulations to deal with the everincreasing problem of the thousands of old automobiles that are junked or abandoned at the roadside.[195]. Generally the trend of such legislation or regulation is to provide both penalties for unlawful abandonment of old cars and a service program to make it easier to leave old cars for sanitation department pickup instead of abandoning them to become an eyesore and a possible hazard. Again, the responsibility for enforcement is generally that of the municipality, which is handicapped in applying the criminal sanctions because the ownership of abandoned cars is usually very difficult to trace after the license plates have been removed.[196]

## NOISE POLLUTION CONTROL

Enforcement of noise control, traditionally a matter of local concern, generally involves police prosecution, with minor criminal penalties.[197] The states however, have long exercised jurisdiction over industrial noise through their industrial noise through their industrial codes administered by the state labor department. Criminal penalties for violations, as well as cease and desist orders and injunctive relief are commonly available; administrative procedures before the state labor department usually precede prosecutive and other judicial remedies.[198] With the greater concern for automobile noise, state muffler legislation has become almost universal, and violations are commonly punishable as misdemeanors.[199] In addition, such legislation is also enforced through state motor vehicle inspection laws.[200]

## PROBLEMS PRESENTED BY PRESENT LEGAL AND ADMINISTRATIVE ARRANGEMENTS--A CRITICAL RECAPITULATION

As indicated by the previous review of environmental legislation, one of the major problems that the present pattern of rule making and enforcement in environmental law presents to effective environmental management is the lack of a unified policy and the disjunctiveness of regulatory and enforcement activities. This lack of integration and disjunctiveness is two-fold. First, there is no integrative principle that in some way ties federal and state development programs into the state and federal environmental control effort. Second, present legislation too often separates the responsibility for rule making and standard setting from the responsibility for enforcement by lodging them at different levels of government. Although there may be adequate reasons for the division of labor, it frequently renders the regulatory effort less effective.

The earlier portion of this paper dealt primarily with specific regulatory efforts in the control of pollution. But, when discussing the lack of integration of policy between development programs and the programs of pollution control, we must consider governmental involvement more broadly. So, for instance, the federal and state highway program has a most significant environmental impact which heretofore either has been disregarded or dealt with in a manner wholly separate and unrelated to programs to regulate environmental pollution. The highway program--aside from possible damage to scenic, historic and aesthetic values--has major ecologic effects in that it may interfere with watershed management, and may adversely affect forests, wildlife and other resources deserving of protection. Just as important as any of these, it may have a major impact on the spread of air pollution from automotive sources. The federal government's support of extensive road-building programs[201] constitutes federal support for internal combustion engines, by encouraging greater use of private automobiles and refined fuels, and in consequence, of automotive air pollution and other environmental affects that stem from fuel refining operations. The production of more automobiles in and of itself makes considerable demands on power resources which in turn require industrial and combustion processes with broad environmental implications. Without entering into any detailed discussion of the social and economic implications of federal road building programs, and even on the basis of a very cursory overview, it is apparent that to consider federal regulatory activities that deal with air pollution, water pollution, and other major environmental pollutants without reference to the federal government's own activities that have a direct or indirect impact on the environment is to tell less than the full story. Thus, federal controls on automotive pollution may be largely neutralized. The present policy preference for roadbuilding over development of means of mass transportation is, thus, a policy which has to be considered as part of the air pollution control picture, as well as, of course, a matter having huge planning, land use, and urban developmental implications.

As to the second aspect of disjunctiveness in environmental policies and programs, it is clear that the dispersal of responsibility among federal, state and local agencies frequently creates confusion and results in ineffective enforcement. A review of the situation in the field of air pollution control provides a focus for discussion. While clearly air pollution is a regional problem in its impact and actual standard setting functions is moving toward the federal government, all of the effective regulatory controls remain lodged on the local level.[202] The federal government still is responsible only for approving regional air quality standards (except in the case of emissions from new automobiles where some federal emission standards have been set). While all of the states have by now enacted state air pollution control codes that set limits on the emission of air pollutants in order to live up to federal standards for the ambient air, it is clear that no fixed formula determines the relationship of emission standards to ambient air quality standards, and the presence of federal air quality standards does not by itself impose upon any state the obligation to reduce emissions from particular sources. Legislative developments already point to the eventual adoption of federal emission standards, possibly national and most certainly regional in scope. But even with adequate federal and state emission standards, enforcement is likely to remain at the municipal level. As pointed out earlier, enforcement is limited by the geographical boundaries of the jurisdiction. Since effective air pollution control must make place at the source of emissions, the jurisdiction which receives the fallout and which suffers the consequences of the emissions is frequently not the one which can regulate the source. In view of the fact that most municipal or other local enforcement agencies operate independently of the state air pollution control agency, enforcement is likely to be very spotty indeed. Moreover, though the standards may be relatively high, having been set at the state level, enforcement at the local level may reflect a response to political pressures which were not present to the same extent at the level at which the policies were first adopted. Thus, though the federal government or the state may limit particular emissions stringently, local enforcement is likely to be lagging when the enforcement efforts would result in limiting the activities of a major employer in the locality.

Present arrangements for policy-making are thus in need of substantial review with a view to restructuring environmental programs on a national or at least regional level. Enforcement activities are similarly in need of review. Traditionally, much of the environmental enforcement effort has been lodged at the local level. Recently legislative developments have begun to place policy-making and standard-setting at higher levels of government, reflecting the insight that effective standards and policies for environmental control cannot be limited within narrow jurisdictional boundaries. The question arises whether what is true of policy-making and standard-setting is not also true of enforcement. Can we rely on the local jurisdiction to enforce the state, regional or national standard if the impact of stringent enforcement will fall primarily on industrial and commercial establishments within the local municipality? While a national air pollution control program would be difficult to operate with thousands of air pollution control inspectors and other enforcement personnel responsible to the National Air Pollution Control Administration in Washington, D. C., new instrumentalities and new enforcement devices should be considered to overcome the constraints that local administration puts on effective enforcement.

A major part of the difficulties in the regulation of environmental pollution is posed by the persistent attempt to deal with regional and national problems on a state or local level, in spite of the fact that is very recent, and our traditional institutions and modes of dealing with it reflect a cultural lag. It is important to remember that less than ten years ago air pollution could still be regarded as a primarily local problem, and that it has been a mere fifteen years since the federal government has involved itself in the regulation of water pollution. Originally the dimension of these problems was such that they could be regarded as local in nature, but air pollution and water pollution are no longer local or even state problems; they have become national problems quite simply because the amount of pollution and the adverse environmental effects have become so great as to burst beyond the boundaries of narrow local jurisdictions. They have simply become too great for municipalities and states to handle on their own. The process is still going on--initially local problems still grow into matters of national concern in environmental pollution. The solid waste disposal problem is an example. Still treated as a primarily local matter, it is becoming more apparent every day that no major municipality has enough land to bury its waste or the facilities to incinerate it would creating major water or air pollution problems that will sprill over municipal--and state--boundary lines.

The persistence of the belief that problems of environmental pollution that are regional and national in their impact can somehow be handled on the local or municipal level continues to have adverse consequences on the effectiveness of regulation. It has been demonstrated that the territorial jurisdiction of many municipalities and local governments and even the territorial jurisdiction of many states--is inadequate to cope with problems of regional air or water pollution. Within metropolitan areas, in particular, the source of emission and the place of fallout are likely to be under different governments. Since local governments have no extraterritorial powers and since state governments rarely intervene in local intergovernmental disputes--particularly where the dispute has its origins in the activities of a private operator--there is frequently no agency that is responsible for abatement. What holds true of different municipalities within one metropolitan area also holds true of interstate regions. When the source of emissions is in one state and the impact is in another, the only available remedies are either federal or else, far less frequently, remedies provided under some interstate compact. The only other remedy, an original suit in the United States Supreme Court is even less frequently invoked.[203] Thus far the federal government has exercised its enforcement powers with great restraint--rarely, and only after lengthy delays, and in emergency situations.

In addition to weaknesses in enforcement caused by limited territorial jurisdiction, disabilities have also been caused by inadequate legal power. This is particularly true of powers granted to local and municipal governments. The powers of municipal government under state constitutional or state legislative provisions are often narrowly circumscribed.[204] Even in instances where a municipality has been granted home rule status, the question whether it may carry out particular functions is often unclear, especiallywhen the state has already asserted a regulatory interest by enacting general legislation.[205] Assuming that the municipality's power to exercise a power on its own is clear, the question of consistency of the local and state code still remains, and unless the local code merely duplicates the state code, there will always be a question whether a different regulatory approach is consistent or inconsistent with the state regulations. When the state merely regulates emissions may the municipality add fuel regulations, or would such fuel regulations be considered inconsistent with the state action? There simply is no clear answer.

Problems of consistency aside, local governments are commonly granted more limited powers of enforcement than state governments. Most of the state codes are presently enforceable by a variety of criminal and civil (including administrative and equitable) sanctions. On the local level, however, enforcement is likely to be by criminal prosecution as for misdemeanor, and the use of civil penalties or equity proceedings is either not authorized at all, or else is only rarely invoked. The limits of the criminal process for effective environmental enforcement have been discussed elsewhere.[206] In view of the relative ineffectiveness of the criminal process to bring about improvements or abatement of conditions, a municipality that can do no more than to prosecute an environmental offender is severely handicapped in its efforts.

In a few areas the federal government has seized hold with full vigor and has claimed preemptive effect for its laws and regulations. While federal preemption may be necessary in some areas, it may also create problems of its own, as, for example, in the area of control of airplane noise and atomic energy. Essentially, federal preemption has tended to create a jurisdictional no man's land where state and localities fear to tread though full regulatory jurisdiction has not been expressly exercised. Federal preemption, both with respect to regulation and enforcement, is clearly called for in many areas of environmental control--when national uniformity is essential by the nature of the problem, or the consideration of regulatory efficiency proves persuasive. The argument for federal preemption, however, need to be examined and clearly articulated in every instance. When a decision is made to use federal power preemptively, it should be made wholeheartedly, to cover the field clearly and decisively in order to avoid the peripheral jurisdictional uncertainties.

The federal government could, constitutionally, assume control of the regulation of all environmental pollution, and it could establish broad interstate regions to carry out its regulatory activities, but it is unlikely to do so both for political reasons and for reasons of administrative economy. Short of such federal assumption of power, the only viable mechanism for regional pollution control management is the interstate compact. Although the interstate compact has not been used to full effect in the regulation of environmental pollution, it appears to be an instrument of considerable flexibility and potential. There are a number of problems with the interstate compact device which will need to be resolved, however, before its full potential may be realized. Considerable attention should be given, first, to redefining the appropriate federal role in such an interstate arrangement. With the dominant federal interest in navigable waters (and, therefore, indirectly in all waters), interstate compacts affecting waterways have invariably had federal representatives, observers, or participants on the regulatory commission.[207] With the exception of the Delaware River Basin Compact, however, interstate compacts have not enjoyed direct federal participation, and the federal government has thus far not seen fit to exercise federal power through interstate compact agencies. The possibility that the federal government might well use interstate compact agencies as executors of federal policy was contemplated and accepted in the promulgation of the Delaware Compact.[208] In order to make the interstate compact device more effective and less likely to conflict with closely related federal interests, the possibility of working out similar relationships in other water pollution compacts, as well as in air pollution control compacts that have been proposed, ought to be considered.

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# GOVERNMENT STRUCTURE FOR ENVIRONMENTAL MANAGEMENT: APPROACHES TO SOLUTIONS

In the planning for effective environmental control a question has been that of the appropriate level of government to make policies and rules and to carry out or enforce them. Brought down to its simplest terms, the question is how wide must a government's territorial jurisdiction be to operate effectively in the control of environmental pollution. To a considerable extent, the question is one in which administrative and legal arrangements ought to follow scientific and technological determinations relating to airsheds, watersheds, etc. Thus, while there is considerable agreement that local control of air pollution is no longer appropriate because the problem by now clearly exceeds local boundaries, there still remains a question as to whether the state, the region, or the nation as a whole is th e appropriate regulatory entity.

For adequate pollution controls, a set of criteria ought to be developed to help determine the conditions which make uniform national or regional standards desirable or necessary. Enough experience has probably been collected in the regulation of air and water pollution to make such criteria possible. Such a set of criteria would then be properly applicable to the planning of mechanisms for the control of other pollutants as well. Thus, the problem of solid waste disposal is clearly emerging from a local and state issue into a national one. The nice question which have to be answered before long is, when is the lack of a local solution to a problem so fraught with regional and national consequences that it properly becomes a regional or national concern? Some developments that invite comparison are taking place in noise pollution control. Because the jet plane--which has brought about the demand for noise controls--is clearly in interstate commerce, federal controls have been developed. In the case of muffler legislation for automobiles--though the automobile is involved in interstate commerce no less than the jet airplance--reliance has been placed on state legislation.[209] Muffler legislation is more effectively enforced as part of state motor vehicle inspection programs, but the need for national uniformity in the case of automobile mufflers may be no less great than the need for uniform standards affecting jet engines.

In all of these instances the problem is two-fold. The issue is not only what level of government should appropriately regulate the problem, but whether policy making and standard setting functions need to be the responsibility of the same level of government that is primarily responsible for enforcement. Thus far these issues have been resolved pragmatically. Since state and local governments were historically concerned with the environment in the traditional exercise of the police power, and since state and local governments, in consequence, were the ones that had staffs of inspectors, sanitarians and other enforcement personnel, enforcement has generally been lodged at the state and local level,[210] although policy making and standard setting has begun to move in the direction of higher levels of government. Thus, though regional air quality standards may be approved by the federal government, the emission controls--if enforced at all--are enforced by the local air pollution control officer. Whether policy and rule making, and enforcement should be divorced in this manner ought to be examined systematically. While the enlargement of federal enforcement machinery is generally looked upon with distrust, if not hostility, the question whether federal standard setting should not, in due course, lead to greater federal involvement in enforcement activities might well be explored. At the very least, devices must be found to prevent narrow local interests from determining the direction and rigor of the enforcement effort.

## Notes *

[2] Jacobson c. Massachusetts, 197 U.S. 11, 25 (1904); Town of Shelby v. Cleveland Mill and Power Co., 155 N.C. 196, 200, 71 S.E. 218, 220 (1911); Berman v. Parker, 348 U.S. 26 (1954).

[3] U.S. v. Carolene Products Co., 304 U.S. 144 (1938); Speert v. Morgenthau, 116 F.2d 301 (D.C. Cir. 1940); U.S. v. Patterson, 155 F. Supp. 669 (N.D. Ill. 1957).

[4] Ch. 758, 62 Stat. 1155 (1948).

[5] Hines, *Nor Any Drop to Drink: Public Regulation of Water Quality, Part III: The Federal Effort*, 52 IOWA L. REV. 799, 800 (1967).

[8] The Water Quality Control Act of 1965, Pub. L. No. 89-234, § 1(a), 79 Stat. 903 (1965), 33 U.S.C.A. 1153 *et seq*. (1970).

[12] S. REP. No. 389, 84th Cong., 1st Sess. 3 (1955).

[16] *See* NATIONAL CENTER FOR AIR POLLUTION CONTROL, U.S. PUBLIC HEALTH SERVICE, A DIGEST OF STATE AIR POLLUTION LAWS (1967).

[18] Motor Vehicle Air Pollution Control Act, Pub. L. No. 89-272, § 102 *et seq.*, 79 Stat. 992 (1965) (now 42 U.S.C. subch. II (Supp. V, 1965-69)).

[24] Emissions standards are now authorized by CAL. HEALTH AND SAFETY CODE §§ 39080 *et seq*. (West Supp. 1970).

[27] H.R. 17,199, 17,200, 17,393, 91st Cong., 2d Sess. (1970) (bills to amend the National Emission Standards Act and to provide for elimination of automotive pollution).

[30] *Hearings on Air Pollution Compacts before the Subcomm. on Air and Water Pollution of the Senate Comm. on Public Works*, 90th Cong., 2d Sess. 459-66 (1968) [hereinafter cited as Hearings on Air Pollution Compacts].

[35] Pub. L. No. 91-190, 83 Stat. 852 (1970).

[36] Halliday, *A Historical Review of Atmospheric Pollution*, in AIR POLLUTION 13, 14 (World Health Organization 1961); CHARLESWORTH, LIABILITY FOR DANGEROUS THINGS 130, 140-42 (1922).

[37] E. W. GARRETT, THE LAW OF NUISANCES 125, 135 (3rd ed. 1908).

[38] COUNCIL OF STATE GOVERNMENTS, SUGGESTED STATE LEGISLATION PROGRAM FOR AIR POLLUTION CONTROL 42-3 (1958); *see also id.*, at 132 (1959).

* See original source for complete footnote references

[39] Pub. L. No. 90-148, 81 Stat. 485 (1967), 42 U.S.C. § 1857 *et seq*. (Supp. V, 1965-69).

[49] Council of State Governments, State Air Pollution Control Act, 26 SUGGESTED STATE LEGISLATION A3 (1967).

[55] *E.g.*, Stamford, Conn., Ordinance No. 21, June 15, 1950; WILMINGTON, DELA., CITY CODE §§ 312-315.

[56] *E.g.*, Fulton County, Ga., Board of Health Reg. No. 2, January 17, 1952.

[57] *E.g.*, St. Paul, Minn., Ordinance No. 9275, May 10, 1949.

[58] *E.g.*, Birmingham, Mich., Ordinance No. 450, April 5, 1954.

[59] *E.g.*, MIAMI BEACH, FLA., CITY CODE §§ 22.68-22.68.9 (1958).

[60] *E.g.*, AIR POLLUTION CONTROL DIST. OF LOS ANGELES COUNTY, RULES AND REGS., Reg. II, Rules 10-14, 17-25, Reg. III, Rules 40, 42-44; CHICAGO, ILL., MUNIC. CODE, ch. 17, May 1, 1959.

[61] Hutchins, *Background and Modern Developments in Water Law in the United States*, 2 NAT'L. RES. J. 416, 422 (1962); Stein, *Problems and Programs in Water Pollution*, *Id*., at 388, 404 (1962).

[68] This ad hoc delegation of regulatory powers to presently existing state agencies is illustrated in Carmichael, *Forty Years of Water Pollution Control in Wisconsin*, 1967 WISC. L. REV. 350, 352-59.

[73] TEX. REV. CIV. STAT. ANN. art.7621d-1, § 3.14 (Supp. 1969).

[83] Comment, *Water Pollution Control in New York* 31 Albany L. REV. 50, 60 (1967).

[91] Bower, *Some Physical, Technological, and Economic Characteristics of Water and Water Resource Systems*, 3 NATURAL RES. J. 215, 219 (1963).

[92] Such a grant may be broad indeed. In Application of City of Johnstown, 12 App. Div. 218, 209 N.Y.S.2d 982 (1961), the "waters of the state" were held to include all fresh water in streams, public or private, even though non-navigable.

[97] PRESIDENT''S SCIENCE ADVISORY COMMITTEE (ENVIRONMENTAL POLLUTION PANEL), RESTORING THE QUALITY OF OUR ENVIRONMENT (1965).

[98] N.Y. PUBLIC HEALTH LAW § 1205(3) (McKinney Supp. 1969).

[100] City of Utica v. Water Pollution Control Board, 5 N.Y.2d 164, 156 N.E. 2d 301, 182 N.Y.S.2d 584 (1959).

[101] City of Huntington v. State Water Committee, 137 W.Va. 786, 73 S.E.2d 833 (1953) (due process); Madison Metropolitan Sewerage District v. Committee on Water Pollution et al., 260 Wis. 229, 50 N.W.2d 424 (1951) (equal protection).

[102] State Board of Health v. City of Greenville, 86 Ohio St. 1, 98 N.E. 1019 (1912); Board of Purification of Waters v. Town of Bristol, 51 R.I. 243, 153 A. 879 (1931).

[106] E.g., N.Y. MUNICIPAL HOME RULE LAW § § 10, 36, 37 (McKinney 1969); 1 NEW YORK CITY CHAPTER AND ADMINISTRATIVE CODE § 751 et seq. (Supp. 1969-70).

[112] N.Y. Times, June 4, 1969, at 34, col. 2.

[116] For a tabulation of these laws, see Kaufman, Control of Noise Through Laws and Regulations in NOISE AS A PUBLIC HEALTH HAZARD 340 (Proceedings of the Conference of the American Speech and Hearing Association, Washington, D. C., June 1968, 1969).

[118] NEW YORK CITY CHARTER AND ADMINISTRATIVE CODE 435-5.0(a) (1963).

[120] CODE OF GENERAL ORDINANCES OF CITY OF PHILADELPHIA § § 10-(401-408) (1956).

[121] MUNICIPAL CODE OF CHICAGO § 99-58 (1969).

[123] N.Y. MULTIPLE DWELLING LAW § 84 (McKinney Supp. 1969-70); 4 NEW YORK CITY CHARTER AND ADMINISTRATIVE CODE RS12-(2-4) (1963).

[124] NEW JERSEY REGS. FOR THE CONSTRUCTION AND MAINT. OF HOTELS AND MULT. DWELLINGS, art. 18, July 19, 1967. Issued pursuant to ch. 76 LAWS OF NEW JERSEY (1967).

[129] 81 Stat. 490 (1967), 42 U.S.C. § 1857(d)(1)(A) (Supp. V, 1965-69).

[135] It has been suggested that this informal procedure is a necessary result of the nature of the conference. It is basically a meeting of all the governmental agencies involved to consider a problem of common concern in the light of all the information available in order to arrive at the remedial action necessary. Edelman, Air Pollution Abatement Procedure Under the Clean Air Act, 10 ARIZ. L. REV. 30, 32 (1968).

[139] U.S. v. Bishop Processing Co., 287 F. Supp. 624, 633 (D.C. Md. 1968), aff'd, 423 F.2d 469 (4th Cir. 1970), cert. denied, 398 U.S. 904 (1970).

[143] 81 Stat. 496 (1967), 42 U.S.C. § 1857d(h) (Supp. V, 1965-69).

[145] The history of the case can be found in 423 E.2d 469, 470 (4th Cir. 1970). *Cert*. was denied in 398 U.S. 904 (1970).

[146] 80 Stat. 1250 (1966), 33 U.S.C.A. § §1160(a), (d) (1) (1970).

[153] Allegheny Airlines v. Village of Cedarhurst, 132 F. Supp. 871 (E.D.N.Y. 1955), aff'd, 238 F.2d 812 (2d Cir. 1956); American Airlines Inc. v. Town of Hempstead, 272 F. Supp. 226 (E.D.N.Y. 1967), aff'd, 398 F.2d 369 (1968) (holding village ordinances explicitly and implicitly barring aircraft from lower air, in an effort to decrease aircraft noise, invalid as conflicting with federal law in an area of federal preemption); 34 Fed. Reg. 18356 (1969) in which FAA posits support of local controls stating "The judicial decisions and legislative history of Public Law 90-411 [the Noise Abatement Act] have made it clear that the Federal Government should not substitute its judgment for that of the airport operation . . . and that the Federal Government should recognize the airport operator's right to issue regulations or establish requirements as to the permissible level of noise which can be created by aircraft using the airport."

[154] 34 Fed. Reg. 18355 (1969) sets forth a summary of public comments generally concluding that standards should be changed.

[166] ". . . the uncertain limits of municipal power have had a stultifying effect on local initiative. Since local officials must consider whether a prospective ordinance might fall outside the area of 'property affairs, or government,' [many will] be restrained in exercising their lawmaking functions." Note, *Home Rule and the New York Constitution*, 66 COLUM. L. REV. 1145, 1154 (1966).

[168] F. Grad, *The State's Capacity to Respond to Urban Problems: The State Constitution* in THE AMERICAN ASSEMBLY, THE STATES AND THE URBAN CRISIS at 46, 47 (A. Campbell ed. 1970).

[180] N.Y. PUBLIC HEALTH LAW § 1242(7) (McKinney Supp. 1969).

[191] State Board of Health v. City of Greenville, 86 Ohio St. 1, 98 N.E. 1019 (1912); Board of Purification of Waters v. Town of Bristol, 51 R.I. 243, 153 A. 879 (1931).

[202] "The state governments' attitude toward pollution control parallels that of the Federal Government profusion of conflicting state agencies dealing with these problems is common. Even more common are the lack of effective power and the miniscule budgets." A. Reitze, Jr., *supra* note 63, at 926.

[203] See, e.g., New Jersey v. New York, 283 U.S. 805 (1931), modified 347 U.S. 995 (1954).

[205] E. Rusco, Municipal Home Rule: Guidelines for Idaho 38 *et seq*. (Bureau of Public Affairs Research, University of Idaho, Res. Mem. *No. 1* (1960).

# POLLUTION ABATEMENT BY REGIONAL ACTION

Joseph F. Zimmerman*

The system of regional governance in the United States is a fragmented one in which many governmental bodies--federal agencies, regular state departments, state controlled public authorities, counties, cities, towns, villages, and special districts--share governmental powers and responsibilities.

This fractionation of responsibility in the typical region makes it extremely difficult to develop and implement a comprehensive environmental enhancement plan. The Council on Environmental Quality, in its First Annual Report, recognized the seriousness of this problem.

> Most government agencies charged with solving environmental problems were not originally designed to deal with the severe tasks they now face. And their focus is often too narrow to cope with the broad environmental problems that cut across many jurisdictions. Agencies dealing with water pollution, for example, typically do not have jurisdiction over the geographic problem area--the watersheds. Control is split instead among sewerage districts, municipalities, and a multitude of other local institutions.[1]

To facilitate the solution of environmental problems, the governmental system of a region can be restructured in accordance with one of the following seven models for regional governance: (1) the Ecumenical Model; (2) the Twin Cities Model; (3) the Special District Model; (4) the Metropolitan County Model; (5) the Metropolitan Toronto Model; (6) the Consolidation Model; or (7) the Compact Model.

## THE ECUMENICAL MODEL

Supporters of the ecumenical model assert that governmental problems, including environmental ones, can be solved by inter-jurisdictional cooperation. The development of comprehensive regional plans, ecumenicists maintain, will act as a stimulus to cooperative action by local governments as the realities of areawide problems are brought into focus and a framework is provided for joint action based upon formal and informal agreements.

Although regional planning commissions are created under the authority of a state enabling act, the establishment of most commissions is attributable to the use of conditional grants-in-aid by the federal government to persuade local governments to sponsor the commissions.

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## COUNCILS OF GOVERNMENTS

By 1965, Congress concluded that metropolitan planning had been ineffective because the planning commissions were not controlled by the local decision makers. Therefore, Congress added a provision to the Housing and Urban Development Act of 1965 making organizations of public officials in metropolitan areas eligible to receive federal grants for the preparation of comprehensive areawide plans.[2]

The following year Congress provided another incentive for integrating planning with decision making by enacting a requirement--popularly known as Section 204 review--that all local government applications for federal grants and loans for thirty specified projects must be submitted for review to the metropolitan organization responsible for areawide planning "which is, to the greatest practicable extent, composed of or responsible to the elected officials of a unit of areawide government or of the units of general local governments."[3]

The importance of metropolitan planning has been further enhanced by the passage of the Intergovernmental Cooperation Act of 1968[4] and the National Environmental Policy Act of 1969.[5] Parts of these two acts and Section 204 of the Demonstration Cities and Metropolitan Development Act of 1966 are implemented by United States Office of Management and Budget Circular A-95 which broadens the coverage of the Section 204 review to 106 programs and extends the review to non-metropolitan areas and the state level.

Ecumenicists in the mid-1960s actively promoted the formation of a Council of Governments (COG), a voluntary association of local governments, in each region as a device to facilitate the solution of areawide problems without changing the structure of the local government system.[6] Most COGs are composed only of general purpose local governments, but a few COGs include representatives of school and other special districts as members.

The Demonstration Cities and Metropolitan Development Act of 1966 induced a number of metropolitan planning commissions to convert themselves totally or partially into COGs while retaining their original names, and others to change their membership and names. Moreover, a number of COGs have assumed responsibility for planning. Consequently, it is difficult to make a sharp distinction between a COG and a regional planning commission.

An example of this arrangement is the Miami Valley Regional Planning Commission located in Dayton, Ohio. MVRPC membership includes five counties and 31 municipalities. The role of MVRPC is basically a planning and coordinative one. A regional "natural resources" study serves as the foundation of environmental planning efforts ("Open Space in the Miami Valley Region" and "Water and Sewer Master Plan"). Plans are implemented by means of the A-95 review process. In addition, MVRPC publishes periodic status reports on the quality of the environment to keep citizens informed on both program successes and failures.

Environmental programs are the most popular services provided to local governments by regional councils. A recent survey (sponsored by the International City Management Association and the Advisory Commission on Intergovernmental Relations) of "Attitudes of Local Officials Toward Regional Councils" found "water and sewer systems" the most significant service offered. Water pollution abatement and solid waste disposal were not far behind.[7]

## ADVANTAGES

One of the greatest advantages of a COG is its ease of organization. In contrast to proposals for a restructuring of the local governmental system, a proposal to create a COG usually encounters little opposition.

A second advantage of a COG is the establishment of a representative forum for the discussion, on a regular basis, of areawide problems. The forum should facilitate the identification and understanding of areawide problems, and may lead to a program of cooperative action to solve them.

Thirdly, a COG is an organized body which may lobby at the State Capitol and in Washington for passage of favorable legislation and defeat of unfavorable legislation.

Fourthly, a COG may serve as a coordinating mechanism for local governments and/or a central secretariat which provides assistance to member governments upon request. Specifically, a COG may promote the signing of inter-local agreements providing for the joint operation of facilities, joint provision of services, and one government providing services to other units.

Fifthly, a COG has territorial boundaries capable of being expanded, in most instances, by a vote of members. COGs may play an important role in facilitating the resolution of inter-state problems since a COG may be formed in such areas with considerably less difficulty than an inter-state or federal-inter-state compact agency.

Finally, a COG is a flexible instrument since any and all units of governments, including school districts may be members.

## DISADVANTAGES

In view of the magnitude of the environmental and other problems in the typical region, one must question whether the problems can be solved by reliance upon voluntary cooperation strengthened by the "carrots" of federal grants-in-aid. The COG approach to the solution of problems suffers from all of the disadvantages of the United Nations approach to the resolution of world problems.[8] Although a large number of COGs were organized in the latter half of the 1960s, they have failed to solve a major problem in any area and many have become inactive.

The reasons why COGs have not scored major successes are not hard to find. Conflicts between the central city and suburban communities have been of long standing in many areas and COGs have been unable to resolve these conflicts.

Secondly, local political leaders owe no fealty to a COG. They generally are interested only in areawide problems which affect their individual communities and have not adopted a regional viewpoint.

Thirdly, many COGs have proved to be little more than debating societies, and their accomplishments have been limited to the preparation of areawide plans which can not be implemented.

Fourthly, it is axiomatic that in order to achieve major results a COG must be composed of representatives of all local governments in the area. If several major units of government refuse to join the COG, its future as an effective coordinating mechanism is limited.

Fifthly, a COG is a voluntary association and every member reserves the right to withdraw from membership.

Finally, a COG may decide that the most effective way to solve a particular functional problem is the creation of a special district, thereby further fragmenting the area's governmental system.

## INTERGOVERNMENTAL SERVICE AGREEMENTS[9]

Formal and informal intergovernmental service agreements have been used by local governments to obtain services for their citizens for well in excess of 125 years. These agreements may be viewed as an adaptive procedural response to problems associated with urbanization since the agreements facilitate the solution of local and areawide problems within the framework of the existing local governmental system.

Although formal and informal agreements may involve any service, formal agreements tend to relate to the supply of water, sewage treatment, and joint facilities. Informal agreements, based on a verbal understanding, relate chiefly to mutual aid and maintenance of highways and bridges.

A great increase in the number of service agreements has occurred since 1945 as the result of the removal of many constitutional and statutory restrictions inhibiting the ability of local governments to enter into service agreements. Currently, forty-two states have a general interlocal contracting act. In twenty-nine of these states, local governments may cooperate with neighboring units in other states.

SERVICES RECEIVED. In 1972, a twenty page questionnaire was sent to 5,900 incorporated municipalities over 2,500 population seeking information on intergovernmental agreements covering seventy-six services. Returns were received from forty per cent of the municipalities.

Sixty-three per cent of the 2,375 respondents reported agreements for the provision of services--including refuse collection (350), sewage disposal (307), solid waste disposal (301), and water supply (297)--to their citizens by other governmental units and private firms.

Larger municipalities generally have the greatest propensity for entering into agreements for the receipt of services. The presence of a larger number of acute problems and suppliers in metropolitan areas accounts for the finding that seventy-five per cent of the central cities and seventy-one percent of the suburban governments have entered into service agreements, compared to only fifty-three per cent of the municipalities in non-metropolitan areas. Agreements are most common in the West where seventy-nine per cent of the local governments report they receive services under agreements and least common in the South where fifty-four per cent of the units reported such agreements.

Municipalities most commonly enter into service agreements with counties and other municipalities. Nevertheless, the state government, public authorities, and private firms are major suppliers of services to local governments.

Relatively few agreements involve a package of services. The bulk of the agreements involve only one service and only two governments--the provider and the recipient of the services. And most binary agreements relate to functions which tend to be non-controversial--civil defense, fire and police mutual aid, jails, and water supply.

Agreements for the joint provision of services and the joint construction and operation of facilities are relatively common. Union agreements differ from standard service agreements in that two or more governmental units join forces to provide the service or construct the facility, a joint body usually is created to administer the

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program, and each participant typically is a coequal partner.

Thirty-five per cent of the reporting municipalities are parties to agreements for the joint provision of services and twenty-one per cent are parties to agreements for the joint construction and operation of facilities. Larger units generally enter into these agreements most often.

Our national survey of the use of service agreements by incorporated municipalities reveals that the role played by inter-local cooperation in the governance of the typical region is a relatively minor one. Although more than three-fifths of the municipalities receive services from other local governments, most agreements are bilateral, involve only a single service, and may be terminated on short notice.

## THE TWIN CITIES MODEL

The Minnesota Legislature, without providing for a popular referendum, created, in 1967, a gubernatorially appointed fifteen member Metropolitan Council for the seven county Twin Cities area.[10] No local governments were consolidated.

The Council assumed the functions of the Metropolitan Planning Commission and was granted authority to review and suspend plans of metropolitan special districts in conflict with the Council's development guide. The Council also was authorized to appoint a non-voting member to the board of each metropolitan special district, conduct research, operate a data center, and intervene before the Minnesota Municipal Commission in annexation and incorporation proceedings. Shortly after the Council's formation, it signed contracts with the State Highway Department and the Metropolitan Transit Commission, thereby assuming responsibility for transportation planning in the area. The Council also has been designated the criminal justice planning agency by the Governor's Crime Commission. Furthermore, the Council has appointed and provides guidance to a health board responsible for coordination of planning for health facilities, manpower, and services.

The Metropolitan Council was designed to be a policy forming rather than an operating agency. However, it assumed responsibility in 1969 for overseeing the performance of two governmental functions, sewer service and parks. Acting upon the Council's request, the 1969 Legislature created two seven-member functional service boards and provided for their appointment by the Council. The Metropolitan Sewer Board[11] and the Metropolitan Park Reserve Board[12] were designed to be operating agencies which would execute policies in their respective areas developed by the Council. The Park Reserve Board's role as an operating body was terminated in 1970 by a Minnesota Supreme Court ruling invalidating laws passed on the 121st day (one day past the constitutional limit) of the 1969 legislative session.[13] The Board, however, was retained by the Council as an advisory body. Opposition from county groups has blocked reenactment of the original Park Reserve Board bill by the Legislature.

The Sewer Board is responsible for wastewater management for the seven county area. They build and control treatment facilities and major sewer lines. The system is financed through the Board, which in turn bills the local governments for services rendered.

The Twin Cities model is an interesting one in that policy-making is divorced from policy execution. The model provides for the Metropolitan Council to determine regional policies which are to be carried into execution by service boards appointed by the Council. In theory, the Council may devote its full attention to broad policy-making for the region.

## QUESTIONS

The desirability of two features of the Twin Cities model may be questioned. First, the regional governmental system is still fragmented in that the Metropolitan Airport Commission (1943) and the Metropolitan Transit Commission (1967) still exist, and responsibility for the performance of major regional functions, other than planning and sewerage disposal, has not been shifted to the Metropolitan Council. In 1969, the Legislature specifically refused to authorize the Council to appoint the members of the Metropolitan Transit Commission. One can argue persuasively that the Council must be granted additional powers if it is to function successfully as a regional government.

The second question involves the desirability of having the Council members appointed by the Governor. Although the members are appointed from districts within the region, they are legally state officials.[14]

## THE SPECIAL DISTRICT MODEL

The failure of comprehensive metropolitan reorganization plans to win voter approval has promoted the organization of regional special districts to solve critical areawide problems. Creation of these districts is facilitated by state laws which usually do not provide for a popular referendum on the question of creating a district.

The governing body of a special district usually is appointed by the Governor or by the cities and towns. Most commonly, special districts are assigned responsibility for facilities and services such as air pollution, airports, bridges, tunnels, terminals, sewage disposal, parks and recreational facilities, public transportation, and water supply. With a few exceptions, these districts are uni-functional. One such exception is the Metropolitan District Commission (MDC) in the Boston area which is responsible for water supply, sewage disposal, certain highways, a police force, and certain parks and recreational facilities. A second exception is the Metropolitan Service District, created in the Portland, Oregon area in 1970, which is responsible for flood control, public transportation, sewage disposal, and solid waste disposal.

ADVANTAGES AND DISADVANTAGES. A multi-functional regional special district clearly is preferable to a system without a governing unit with regionwide jurisdiction or a system in which there are several uni-functional regional districts.

Creation of a special district responsible for all functions most suitable for regional performance would consolidate responsibility in one body and enable it to develop priorities and coordinate programs. And the establishment of such a district would forestall the creation of additional uni-functional units such as a solid waste disposal district.

A major disadvantage of the special district model is that citizen control usually is lacking, and this may result in citizen apathy within the district. A related danger is the possibility that the district may function as an autonomous unit responsible to no one. A second disadvantage flows from the fact that most regional special districts perform only one or a few closely related functions, resulting in a fractionated assault on regional problems.

## THE METROPOLITAN COUNTY MODEL

Many students of metropolitan politics are convinced that serious obstacles lie in the path of any proposal to reform the governmental system in any area by consolidating local governments or creating a new upper tier unit. These observers have concluded that the most feasible method to create an areawide government would be to reform the existing county government which usually has authority and an outmoded organizational structure.

A metropolitan county may be developed either by the incremental approach or the revolutionary approach. Los Angeles County, which developed as a major provider of urban services since the turn of the century represents the first, and Dade County, Florida, which adopted a home rule charter in 1957, represents the second.[15]

The incremental strengthening of county government in a number of states during the past decade is a significant governmental development. An example of this trend is the 1968 amendment to the Pennsylvania Constitution which classifies the county as a municipality and extends home rule to it. In other words, a county by adopting a home rule charter becomes a municipal corporation and may perform the same functions as any city, township, or borough, provided the charter authorizes the performance of the functions.

Of particular interest to environmentalists is the Volusia County (Daytona Beach), Florida charter approved by the voters on June 30, 1970. The charter grants the County the power of preemption with respect to protection of the environment.

> County ordinances shall prevail over municipal ordinances whenever the County shall set minimum standards protecting the environment by prohibiting or regulating air or water pollution or the destruction of the resources of the County belonging to the general public.[16]

ADVANTAGES AND DISADVANTAGES. A metropolitan county government has four principal advantages. First, an upper tier unit of local government would be established with sufficient powers to solve major regional problems. Second, political fragmentation will be ended on the regional level if responsibility for all regional programs is assigned to the county government. Third, the county government will be able to coordinate regional programs to prevent duplication and conflict. Fourth, service and tax districts may be established so that services are paid for in most cases by citizens who primarily benefit from the services rather than by all taxpayers.

A disadvantage of the metropolitan county model in the minds of some citizens is the loss of certain powers by cities, towns, and villages. In other words, the model will by opposed strenuously by those who view it as an encroachment upon municipal "home rule."

A second disadvantage involves the problem of determining the division of powers between the two tiers of government and conflicts which may arise between the two tiers after the powers are divided. A related problem is the possibility that it may become necessary to redistribute functional responsibility between the tiers with the passage of time because of changing conditions.

Finally, only 130 of the 269 Standard Metropolitan Statistical Areas fall within the confines of a single county. In other words, the territorial jurisdiction of a majority of urban counties is too restricted to enable them to function as metropolitan governments. County boundaries, of course, may be redrawn, but attempts to redraw the boundaries will meet strong political opposition.

## THE METROPOLITAN TORONTO MODEL

Patterned after the federal relationship which exists between the national government and the states, metropolitan federation is a compromise between the existing fragmented political system and total amalgamation of the units of local government. Metropolitan federation always involves the creation of a new areawide government; existing local governments may be continued or partially consolidated. The federation model is a flexible one in that functions can be transferred from local units to the areawide government as conditions change.

A metropolitan federation was created in the 240 square mile Toronto area on January 1, 1954 by the unilateral action of the Ontario Legislature.[17] A twenty-four member Metropolitan Council, possessing legislative and administrative powers, was established as the upper tier government; no municipalities were merged. Acting upon the report of the Royal Commission on Metropolitan Toronto, the Ontario Legislature in 1966 reduced the number of municipalities from thirteen to six and increased the size of the Metropolitan Council to thirty-three members. Twelve seats are allotted to officials of the City of Toronto and twenty seats to officials of the five Boroughs. The Council appoints its Chairman who need not be a member of the Council.

Proponents of the federated model argue that pollution abatement and large projects requiring a considerable capital investment and benefiting a wide area--major parks, transportation facilities, and refuse and sewage disposal facilities--should be the responsibility of an upper tier unit since it would be in a position to launch needed programs, mobilize financial resources in an equitable manner, and achieve economies of scale. They further argue that the regional entity should be a multi-functional one in order to permit the development of priorities and ensure that there is effective coordination of projects and programs.

The state of Colorado has recently established procedures to set up urban service authorities. These authorities would be formed with approval of a majority of the local governing bodies and approval of the voters. Voters would also select a board of directors and select the functions the authority would control. The first test of this concept will come this fall when voters decide on a proposed four-county authority for the Denver area.

ADVANTAGES AND DISADVANTAGES. Assuming that the upper tier unit in the federated model is assigned the same powers as those assigned to the metropolitan county, the upper tier unit in the federated model would have the same basic advantages and disadvantages as the metropolitan county. The major differences between the models are two-fold. First, the federated model requires the creation of a new upper tier unit whereas the metropolitan county model utilizes an existing unit of government. Second, the federated model has flexible territorial boundaries and is not limited by county lines.

## THE CONSOLIDATION MODEL

The consolidation model requires the use of annexation by the central city and/or merger of local governments to form a single local government for a metropolitan area.

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The term consolidation also is used to refer to the consolidation of functions which occurs when a function is shifted to a higher level of government. In addition, establishment of a metropolitan federation may be referred to as a type of consolidation in view of the fact certain functions are taken away from municipalities and assigned to the newly created upper tier unit.

In discussing city-county consolidation, it is important to distinguish two types--complete and partial. In the first type, a new government is formed by the amalgamation of the county and all other local governments within the county. Partial consolidation may take two forms. In the first form, most county functions are merged with the central city and/or other municipalities to form a new consolidated government, but the county government continues to exist for the performance of a few functions mandated by the state constitution. A second form of partial consolidation involves the merger of several but not all municipalities with the county. Six small cities, for example, were exempted from the consolidation of the City of Nashville and Davidson County in 1962.

ADVANTAGES AND DISADVANTAGES. According to its proponents, complete consolidation of all local governments has the advantages of simplifying the governmental structure in the area, consolidating responsibility, eliminating duplication, mobilizing the resources of the area, promoting the orderly development of the area, solving major areawide problems, increasing popular control, and achieving economies of scale. Complete consolidation by definition achieves the first four goals. Whether consolidation will achieve the other goals is debatable.

Campaigns to consolidate local governments usually have encountered strong political resistance. The main objection to complete consolidation has been the fear of centralization of authority and the establishment of a remote and unresponsive local government. Residents of small municipalities complain that consolidation will reduce their control over the local government since they can be outvoted on any issue. And many blacks believe that consolidation is motivated by the desire of whites to prevent blacks from gaining control of the central city.

## THE COMPACT MODEL

Aware of the need for a device to facilitate cooperative action by the states on a regional basis, the framers of the United States Constitution authorized states to enter into compacts with the consent of Congress.[18]

Interstate compacts may be classified as non-agency and agency compacts. The former refers to agreements entered into by states for cooperative action by regular state agencies. The latter refers to agreements which create a multi-state governmental entity. The best known metropolitan interstate compact agency is the Port Authority of New York and New Jersey which was created in 1921 to develop and operate transportation and terminal facilities in an area radiating twenty-five miles out from the Statute of Liberty in New York City harbor.

One of the oldest pollution abatement compact agencies is the Interstate Sanitation Commission which came into existence in 1935 following Congressional consent.[19] The Commission was created by a compact entered into by Connecticut, New Jersey and New York. Although the Commission's primary function is water pollution abatement, the Commission was authorized in 1956 to study the air pollution problem within its territorial jurisdiction and report its findings to state and local enforcement agencies.

A most interesting organizational innovation has been the use of the federal-interstate compact whereby the federal government becomes a direct partner with states in a program designed to solve various interstate problems. Federal-interstate compacts are to be contrasted with interstate compacts which involve only states and require the consent of Congress only if they are political in nature.

The Delaware River Basin Compact, signed in 1961 by the federal government and four states, is the best-known federal-interstate compact. The Delaware River Basin Commission is in charge of water resource management in the Basin, and is composed of the Governors of the States of Delaware, New Jersey, New York, and Pennsylvania and a commissioner appointed by the President of the United States.

On January 30, 1967, President Lyndon B. Johnson transmitted a message to Congress recommending the enactment of the Air Quality Act of 1967 which, among other things, would have authorized the Secretary of Health, Education, and Welfare to establish regional air quality commissions.[20] The President's message stimulated counteraction in Connecticut, New Jersey, and New York. A bill was enacted in each state establishing the Mid-Atlantic States Air Pollution Control Compact, a federal-interstate compact covering a five state area. According to its provisions, the compact becomes effective when approved by three states and Congress.[21]

Patterned after the Delaware River Basin Commission, the Mid-Atlantic States Air Pollution Control Commission would be composed of the signatory states and a federal representative designated by the President. The Compact would empower the Commission to investigate the sources of air pollution, undertake research on pollution abatement, and establish and enforce air quality standards. However, existing air pollution control agencies would be responsible for enforcing the standards, and any "state or local law, code, ordinance, rule, or regulation may be more restrictive than any requirement in effect pursuant to this compact."[22]

Although a joint resolution was introduced in the United States House of Representatives and Senate on June 22, 1967 consenting to and entering into the Mid-Atlantic States Air Pollution Control Compact, Congress has not given its consent.[23]

ADVANTAGES AND DISADVANTAGES. The greatest advantage of the compact model is that it provides for the creation of an agency with sufficient power to solve environmental and other problems which transcend state boundary lines. While some state agency officials view a compact agency as a competitor, other state officials favor the use of a compact agency as a device to forestall total federal preemption of responsibility for solving certain interstate problems. A third advantage of a federal-interstate compact, according to its proponents, is the establishment of a formal mechanism for coordinating federal programs with related state programs.

The major disadvantage of a compact agency is the relative lack of citizen interest in the agency's operations since the agency is not directly controlled by the citizens. A frequent complaint directed against compact agencies is that they are autonomous governmental entities responsible to no one.

## CONCLUDING COMMENTS

Freedom of environmental systems from the arbitrary constraint of political boundaries is easy to see; a smog front drifting in with the wind from a nearby metropolitan area, sewage floating and flowing into your community from upstream. This varying nature of environmental systems makes managing the environment a

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diffcult problem for local governments. As we have seen, environmental problems have increasingly served as a stimulus to seek regional solutions.

Yet, experience to date reveals that interlocal cooperation has played a relatively minor role in solving environmental problems transcending local boundary lines, and that there is little interest in consolidation of local governments except in certain southern metropolitan areas. These facts suggest that the federated models--Twin Cities, Special District, Metropolitan County, or Metropolitan Toronto--have the best prospect for solving major environmental problems in most regions.

Regardless of which federated model is followed in reshaping the governmental system in any region, certain questions will have to be answered. First, a decision has to be made relative to which functions are to be the exclusive and shared responsibility of the upper tier local unit.

In designing a new or restructured upper tier unit several possible transfers of authority should be explored: (a) devolution of certain powers from the State level, (b) a lateral transfer of authority to the new or restructured unit from existing regional bodies, (c) an upward shift of certain powers from counties, cities, towns, and villages, and (d) a combination of these approaches.

A second question involves the nature of the governing body of the upper tier unit. Should it be composed of mayors and other local chief executives as ex officio members? Should it be appointed by the local governments? Should it be appointed by the Governor? Should it be popularly elected? Should it be selected by a combination of methods? Some members might be appointed by the Governor, others might be appointed by the local governments, and still other members might be popularly elected.

A third question involves the United States Supreme Court's "one-man, one-vote" ruling.[24] If the designers of the governing body of the upper tier unit decide to have the members appointed by the Governor or elected at-large, the Court's ruling will not have to be considered. If the members are elected by districts, the electoral system will have to be based on substantially equal population districts. The unit system of representation--each lower tier unit is represented by one member on the upper tier's governing body--can be employed only if weighted voting is adopted. Under a system of weighted voting, the weight of the vote cast by each member is in direct proportion to the population represented.

Provision must be made for the adjustment of the boundaries of a regional government to cope with changing conditions. We have had enough experience with immutable municipal boundaries to know that they are undesirable. A boundary commission could be created as part of the new regional entity and be authorized to determine its initial boundaries and later make adjustments by applying prescribed criteria.

Who should design the new upper tier unit? This is probably the most difficult question that has to be answered. One possibility is the enactment of a law by the State Legislature authorizing the appointment or election of a commission charged with the duty of drafting a charter for a regional unit and submitting the charter to the electorate. A second alternative would be for the State Legislature to design the new unit. A third possibility would be the passage of a law by the State Legislature empowering the Governor to appoint a commission with authority to conduct research, hold public hearings, and prepare a plan for upper tier local government. The plan would become effective ninety days after its presentation to the next session of the Legislature unless vetoed by it. Local governments, either through a COG or ad hoc organization could be afforded the opportunity to prepare an alternative plan which would become effective if it is approved by the commission and is not vetoed by the Legislature.[25]

# NOTES

[1] *Environmental Quality: The First Annual Report of the Council on Environmental Quality* (Washington, D.C.: United States Government Printing Office, August 1970), p. 15.

[2] Housing and Urban Development Act of 1965, 79 STAT. 502 (1965). 40 U.S.C. 461 (g) (1965).

[3] *Demonstration Cities and Metropolitan Development Act of 1966*, 80 STAT. 1255, 42 U.S.C. 3301-314 (1966).

[4] *Intergovernmental Cooperation Act of 1968*, 82 STAT. 1103, 42 U.S.C. 4201-243 (1970).

[5] *National Environmental Policy Act of 1969*. 83 STAT. 852, 42 U.S.C. 4321 and 4331-332 (1972).

[6] Joseph F. Zimmerman, "The Planning Riddle," *National Civic Review*, April 1968, pp. 189-94.

[7] Douglas Harman and Mary Ann Allard, "Local Evaluation of Regional Councils," *Urban Data Service Report*, March 1973, p.3.

[8] Joseph F. Zimmerman, "Metropolitan Ecumensim: The Road to the Promised Land?" *Journal of Urban Law*, Spring 1967, pp. 433-57.

[9] This section is based on data collected for a larger study of substate regionalism being conducted by the Advisory Commission on Intergovernmental Relations under the direction of Dr. Carl W. Stenberg. See Joseph F. Zimmerman, "Intergovernmental Service Agreements" in *Substate Regionalism* (Washington, D.C.: Advisory Commission on Intergovernmental Relations, forthcoming), chap. III.

[10] *Minnesota Statutes*, chap. 473B.

[11] *Ibid.*, chap. 473C.

[12] *Ibid.*, chap. 473E.

[13] *Knapp v. O'Brien*, 179 N.W. 2d 88 (1970).

[14] For more details on the Council, see Joseph F. Zimmerman's "Metropolitan Governance and the Twin Cities Model," an address presented at the National Conference on Government, Minneapolis, Minnesota, November 28, 1972 (Mimeographed).

[15] For the most complete and up-to-date information on county government, see the Advisory Commission on Intergovernmental Relations' *Profile of County Government* (Washington, D.C.: United States Government Printing Office, January 1972).

[16] *Volusia County (Florida) Charter*, Sec. 1305.

[17] The Municipality of Metropolitan Toronto Act, 1953 is reproduced in Joseph F. Zimmerman, ed., *Metropolitan Charters* (Albany: Graduate School of Public Affairs, State University of New York at Albany, 1967), pp. 87-138.

[18] *Constitution of the United States*, art. 1, Sec. 10, cl. 3.

[19] *Interstate Sanitation Compact*, 23 U.S.C. Sec. 71-73 (1964).

[20] *"Air Pollution--Message from the President of the United States*, 113 *Congressional Record* H737, January 30, 1967.

[21] *Connecticut General Statutes*, Sec. 19-523 and 19-524.
*New Jersey Statutes Annotated*, Sec. 32.29-39 (Supp. 1970).
*New York Public Health Law*, Sec. 1299-m (McKinney Supp. 1967).

[22] *New York Public Health Law*, Sec. 1299-m, art. 2, Sec. 2.8 (b) (McKinney 1967).

[23] For further details, see Joseph F. Zimmerman, "The Role of the State Legislature in Air Pollution Abatement," *Suffolk University Law Review*, Spring 1971, pp. 850-77.

[24] *Avery v. Midland County, Texas et al*, 390 U.S. 474 (1968).

[25] For further details, see Joseph F. Zimmerman, "Substate Regional Government: Drafting a New Procedure," *National Civic Review*, June 1972, pp. 286-90.

# AN ANALYSIS OF INSTITUTIONAL FORMS FOR INTEGRATED REGIONAL ENVIRONMENTAL MANAGEMENT

L. Edwin Coate*

## IREM: A Case Study in San Diego County

Most identifiable environmental problems within San Diego County are closely related to the overall phenomenon of population growth. The County's chief consumable natural resource is its undeveloped land. Because of the tremendous economic pressure for rapid development, major parts of that resource are likely to be irreversibly committed to a long-term land use pattern without consideration of nvironmental effects beyond the boundaries of individual development projects.

The number one environmental problem identified by the people of the region is air pollution. Meteorological and topographical factors in the San Diego region make it highly susceptible to air pollution problems. In a five-year study, San Diego had 60 percent more days than Los Angeles with weather conditions that could have led to air pollution episodes. Rapid growth and land use planning with insufficient attention ot it's implication for air quality could intensify the potential air problem.

As a result of this and other concerns an Environmental Development Agency was created in early 1971 during a County reorganization. Various environmentally related functions, including both regional planning and community zoning were consolidated. The Environmental Development Agency was located under the County's Chief Administrative Officer who is directly responsible to the County Board of Supervisors.

In April, 1971, the Ford Foundation awarded the County of San Diego a $725,000 grant for the two-year Integrated Regional Environmental Management (IREM) Project. The IREM Project was located in the existing Environmental Development Agency. In addition to it's own staff of about 30 persons, IREM utilized consulting firms, university contracts, staff consultants and staff from other governmental agencies through interagency agreements.

The goal of the IREM Project was to determine what environmental management was and how effectively it could be accomplished on a regional level by a local government. This included determining appropriate programs and regional institutional relationships. The Project's purposes were to work within the County government framework to:

1. Respond to Federal and state legislative requirements;
2. Mobilize community resources and support decision-makers;
3. Respond to citizen concerns as articulated by the Board of Supervisors;

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Remarks taken from a paper presented at the Regional Environmental Management Conference, February 26-27, 1973, San Diego, California.

4. Enhance the regional image; and

5. Provide a rational approach to environmental issues.

In light of the general goal and specific purposes, the IREM Project formulated the following set of objectives:

1. The Identification of Natural Resources.

2. The Integration of Resources for Action.

3. Provision of Information to Decision-makers.

4. Development of New Technologies.

5. Development of Management Processes and Programs with National Application.

6. Validation of Environmental Standards.

7. Development of a Regional Project Management Capability.

8. Identification of Needs for Institutional Change.

The final organization plan used by IREM divided the Project into two functional areas: (1) A Program Management Activity with responsibilities for policy development, and for the technical management of research, development, and demonstration projects; and, (2) a Regional Environmental Services activity to provide a capability for reacting to immediate issues, for implementing pilot programs, and for community service.

The Program Management activity was further divided into sections dealing with: Land Use Analysis; Pollution Management; and Communication and Evaluation. The Regional Environmental Services activity was divided into sections dealing with: Economic Analysis; Community Involvement; and Environmental Impact Analysis.

It soon became evident that if a true regional environmental management capability was to be achieved, definite linkages had to be established between IREM and other environmental institutions in the region. To develop a strategy for building these linkages, the environmental issues and problems facing the region were identified. These programs provided the series of transitions through which IREM would slowly and incrementally build the necessary institutional bonds within the region.

During the early months of the Project, IREM identified 23 major program study areas. Of these, some were quickly discarded as inappropriate or infeasible for IREM, while others were developed to various degrees of complexity. One major effort was a regional Natural Resource Inventory to document natural resource information essential for land use and public works decision-making, as well as for long-term planning, environmental impact review and measurement of our current regional environmental status. Computer graphics techniques developed by IREM were put to use on several regional land use projects. Also, IREM staff prepared a series of issue papers on environmental problems facing the region.

At the end of its first year, IREM staff focused its program to the following areas:

1. Environmental Impact Statement Review;

2. The San Diego Clean Air Project, funded by a $425,000 grant from the Environmental Protection Agency, focusing on alternative courses by which the County could meet the 1975 air quality standards;

3. The development of an Environmental Element for the General Plan, beginning with coastline management and open space data;

4. State-of-the Environment Reporting to produce a status report on the environmental condition of the region, through a set of environmental quality indicators;

5. A Joint City/County Economic Analysis of Regional Growth, aimed at determining the economic effects of new large-scale subdivisions on the region, and representing the establishment of an institutional link between IREM and the City of San Diego;

6. University Collaboration - under a $130,000 grant from the National Science Foundation, a series of five research projects were coordinated, not only to provide solutions to regional environmental problems, but also to test the effectiveness of local government-university collaboration for such problem solving.

7. Public Information, including a monthly environmental education newspaper for the County schools and natural resources publications;

8. Institutional Analysis, involving a proposed reorganization of the County's Environmental Development Agency;

9. Issue Analysis for decision-makers especially responding to environmental issues at the request of the Board of Supervisors.

Through these various programs, at the end of one and one-half years of its Project life, IREM had developed a strong network of institutional linkages in the region, as well as with the State and Federal governments. (See Figure 1). Institutional relationships developed by the IREM Project can be characterized by the following: (1) Program Collaboration; (2) Financial Assistance; (3) Information Exchange; and (4) Issue Analysis.

What was learned about regional environmental management from the IREM experience? From the IREM case study, it can be concluded that, to be most effective, regional environmental management must relate agencies involved in land use and transportation planning to those which are responsible for regulatory pollution management functions. An effective regional environmental management agency must have linkages to all the key environmentally related institutions in the region. The IREM experience also led to the conclusion that effective regional environmental management had to be carried out with some type of authority or under a definite mandate. Advisory functions and research and development functions were necessary and important, but proved inadequate by themselves. IREM, located as it was in a County government, could not effectively fulfill all of these various criteria.

In light of the IREM experience and what has occurred at the other governmental levels, it is possible to design a model of a more effective institutional form for regional environmental management.

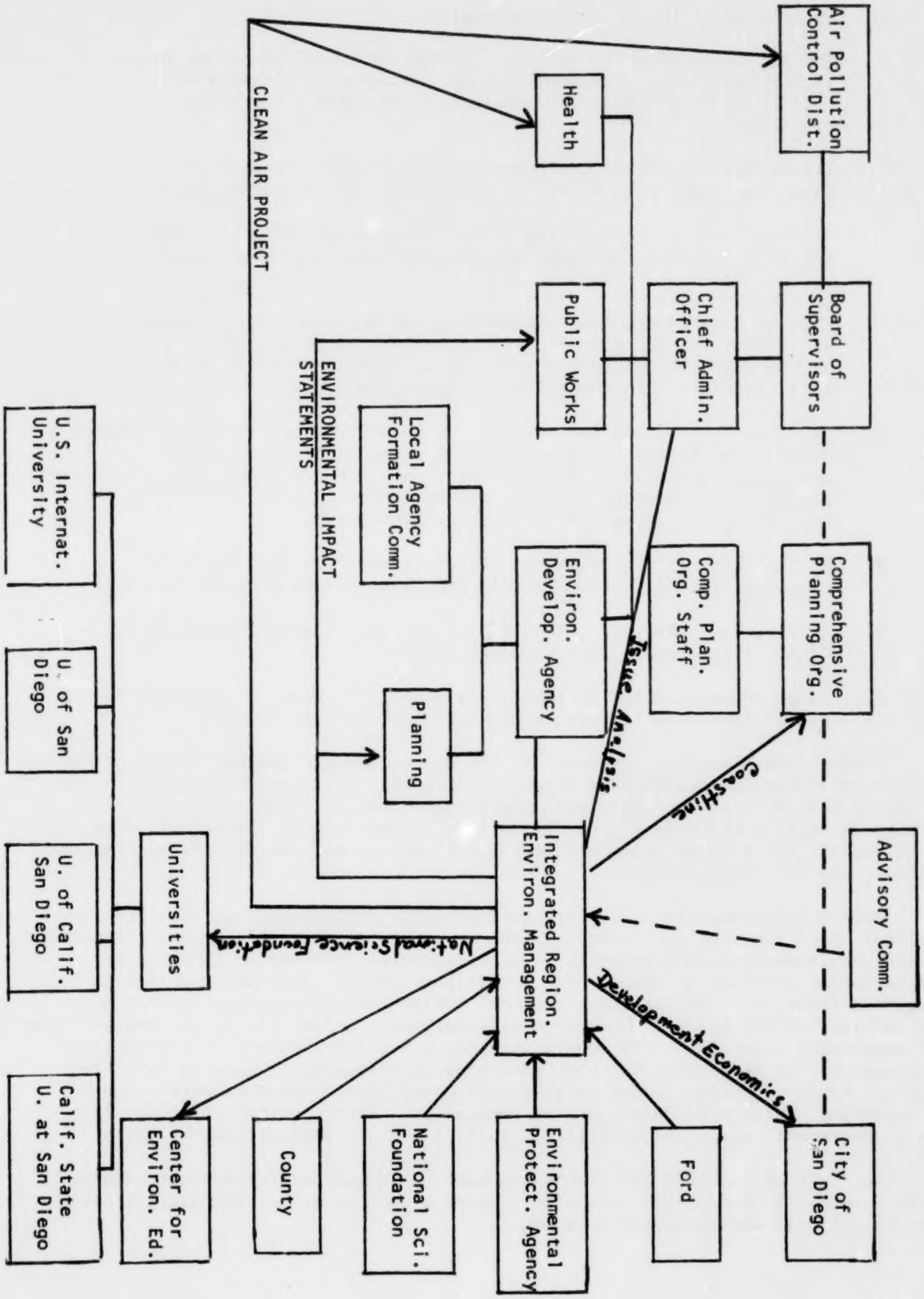
Air Pollution Control Dist.
Board of Supervisors
Comprehensive Planning Org.
Advisory Comm.
City of San Diego
Health
Chief Admin. Officer
Comp. Plan. Org. Staff
Public Works
Environ. Develop. Agency
Local Agency Formation Comm.
Planning
Integrated Region. Environ. Management
Ford
Environmental Protect. Agency
National Sci. Foundation
County
Center for Environ. Ed.
Universities
U.S. Internat. University
U. of San Diego
U. of Calif. San Diego
Calif. State U. at San Diego
CLEAN AIR PROJECT
ENVIRONMENTAL IMPACT STATEMENTS
Issue Analysis
Coastline
Development Economics
National Science Foundation

Figure 1.

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## A Model for Achieving Integrated Regional Environmental Management

This proposed model would provide for a consolidation of the planning and management functions of land use and transportation agencies with those of agencies responsible for pollution regulation. The model focuses on a Regional Environmental Board, the jurisdiction of which is a natural region. This Regional Board would report to a State Environmental Board. The functions of the Regional Board would be advisory, regulatory, and research and development.

The Regional Environmental Board would be composed of six members, three appointed by the State Board and three appointed by a Regional Selection Committee. This Selection Committee would include two members from any County Board of Supervisors which has jurisdiction over part of the area, the Mayor of any city which lies partly or wholly in the region and three Special District Representatives selected as a result of a conference of Special Districts in the region. The Selection Committee would choose three persons to represent their region as a whole.

The six Regional Board members would serve staggered six-year terms. One of the Regional Board members would have extensive experience in the field of pollution regulation and control; one in conservation and natural resources management; and a third in land use and transportation planning or environmental management.

Members of the Regional Board would be full-time, meeting whenever necessary. The Regional Board would have the power to:

1. Conduct hearings and investigations anywhere in the region;
2. Recommend to the State Legislature specific environmental proposals;
3. Carry our environmental management duties such as: (a) standard setting, (b) preparing plans, (c) issuing cease and desist orders, (d) denying building permits in environmentally sensitive areas, (e) requiring local agencies to assist in regional environmental management activities, and (f) reviewing regulations set forth by local agencies;
4. Review projects with regional significance, test them against established regional environmental policies and objectives and, if appropriate, disapprove the projects or require their modification;
5. Review and disburse Federal, state and local funds;
6. Contract for services and appoint groups; and
7. Enforce powers by fining individuals and groups when necessary.

Finally, the Regional Board would prepare, on an annual basis, a State-of-the-Environment Report detailing the status and conditions of environmental problem areas, including a discussion of programs under way in the region to improve the environment.

Although the Regional Board's departments can be separately and functionally described, it is to be kept in mind that the key to the success of the environmental management model is the way the different departments integrate and relate their planning and management functions on a day-to-day basis.

The Departments include: (1) Air Quality, Noise and Radiation Regulation; (2) Water Quality and Supply; (3) Resources Recovery and Solid Waste Management; (4) Land Use and Transportation Planning; (5) Environmental Impact Analysis; and (6) Research and Analysis.

The functions and programs of the various departments would undoubtedly vary according to local/regional circumstances. An example of how the model would look if implemented in the San Diego region is shown in Figure 2. The San Diego IREM case study showed the necessary institutional linkages, but also illuminated the difficulty of achieving such implemental and integrated powers at the regional level from within a County government.

Some type of regional authority is essential to implement the proposed model. Accordingly, four implementation alternatives are proposed: (1) a newly created Regional Agency mandated by the state; (2) a City/County merger; (3) a strengthened Council of Governments (with taxing powers); and (4) a Regional Center for Environmental Coordination.

## State Mandated Regional Agency

Under this alternative, the regional model would be imposed by the state. Specific examples of this approach already exist: Assembly Bill 681 introduced into the California Legislature by Assemblyman Edwin L. Z'Berg to create a pollution management agency; and Proposition 20, the citizens' ballot initiative which has created the Coast Regional Commission.

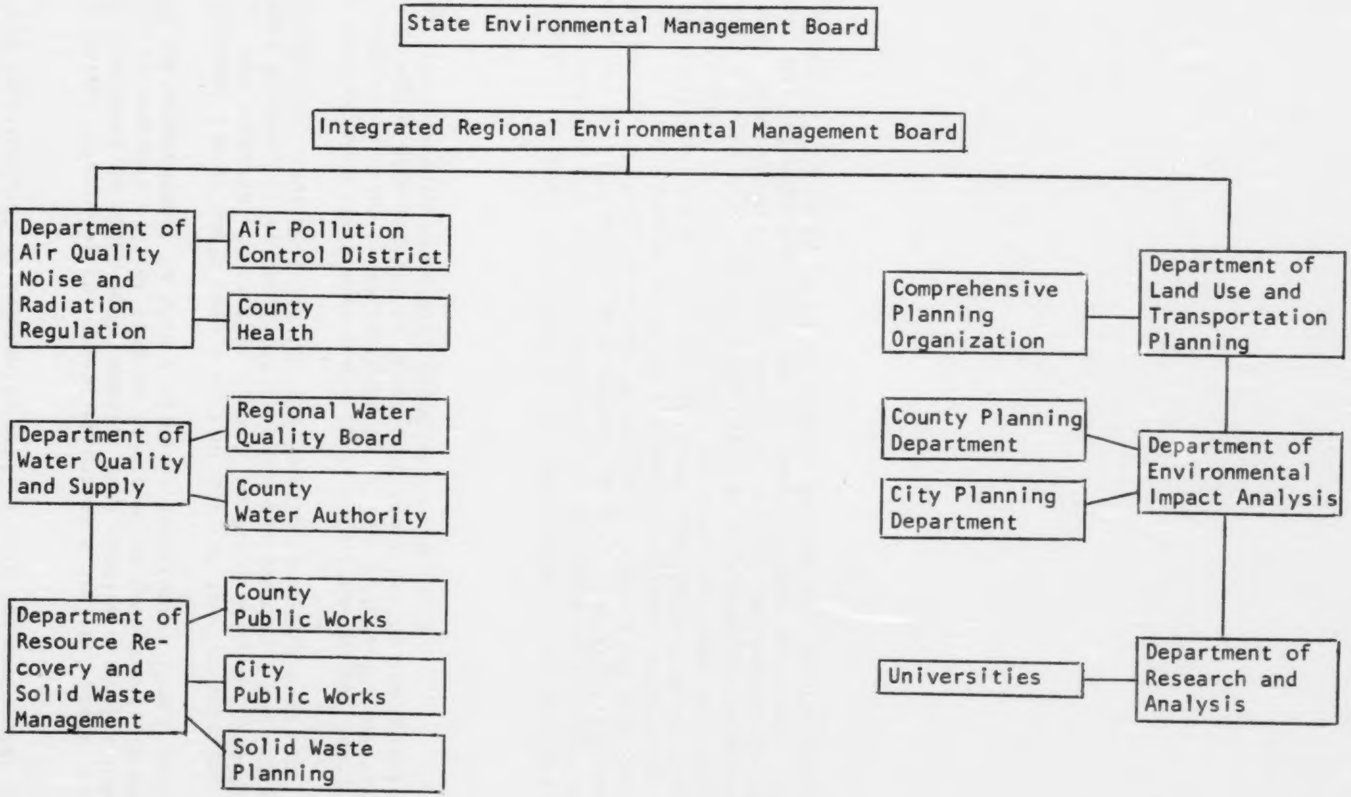
## City/County Merger

The model could also be implemented by a merger of existing local agencies. In an attempt to solve the usual duplication of efforts and conflicting decisions, the two major local government entities could consolidate decisions, the two major local government entities could consolidate through the creation and adoption of a City/County Charter. This type of merger has numerous well-known precedents such as Nashville-Davidson in Tennessee, Miami-Dade in Florida, Indianapolis and San Francisco. The regional government created would be able, by merging various departments and resources, to create a "superagency" which would have equivalent functions to the Regional Environmental Board proposed in the model.

## Strengthened Council of Governments

This plan requires the regional Council of Governments to acquire broad implementation authority over pollution management agencies as well as implementation powers over the land use and transportation functions. It would be able to review each local agency's capital improvements program to make sure plans were of benefit to the region as a whole. It would also have taxing powers to make it independent from existing agencies in the region. An example of such an arrangement was Assembly Bill 3050, the San Diego Council of Governments Act, introduced into the 1971 California Legislature by then-Assemblyman Pete Wilson.

Figure 2


State Environmental Management Board
Integrated Regional Environmental Management Board
Department of Air Quality Noise and Radiation Regulation
Air Pollution Control District
County Health
Department of Water Quality and Supply
Regional Water Quality Board
County Water Authority
Department of Resource Recovery and Solid Waste Management
County Public Works
City Public Works
Solid Waste Planning
Comprehensive Planning Organization
Department of Land Use and Transportation Planning
County Planning Department
City Planning Department
Department of Environmental Impact Analysis
Universities
Department of Research and Analysis

## Regional Center for Environmental Coordination

This alternative is merely an interim model if none of the above alternatives are immediately possible. It would be a logical modification of the IREM Project and its institutional relationships until a true regional model could be implemented.

The principal concept is the establishment of a Regional Center for Environmental Coordination which would consist of a captive nonprofit research institute with counterpart offices located in the major governments in the region. A link to the state government is also critically important. (See Figure 3)

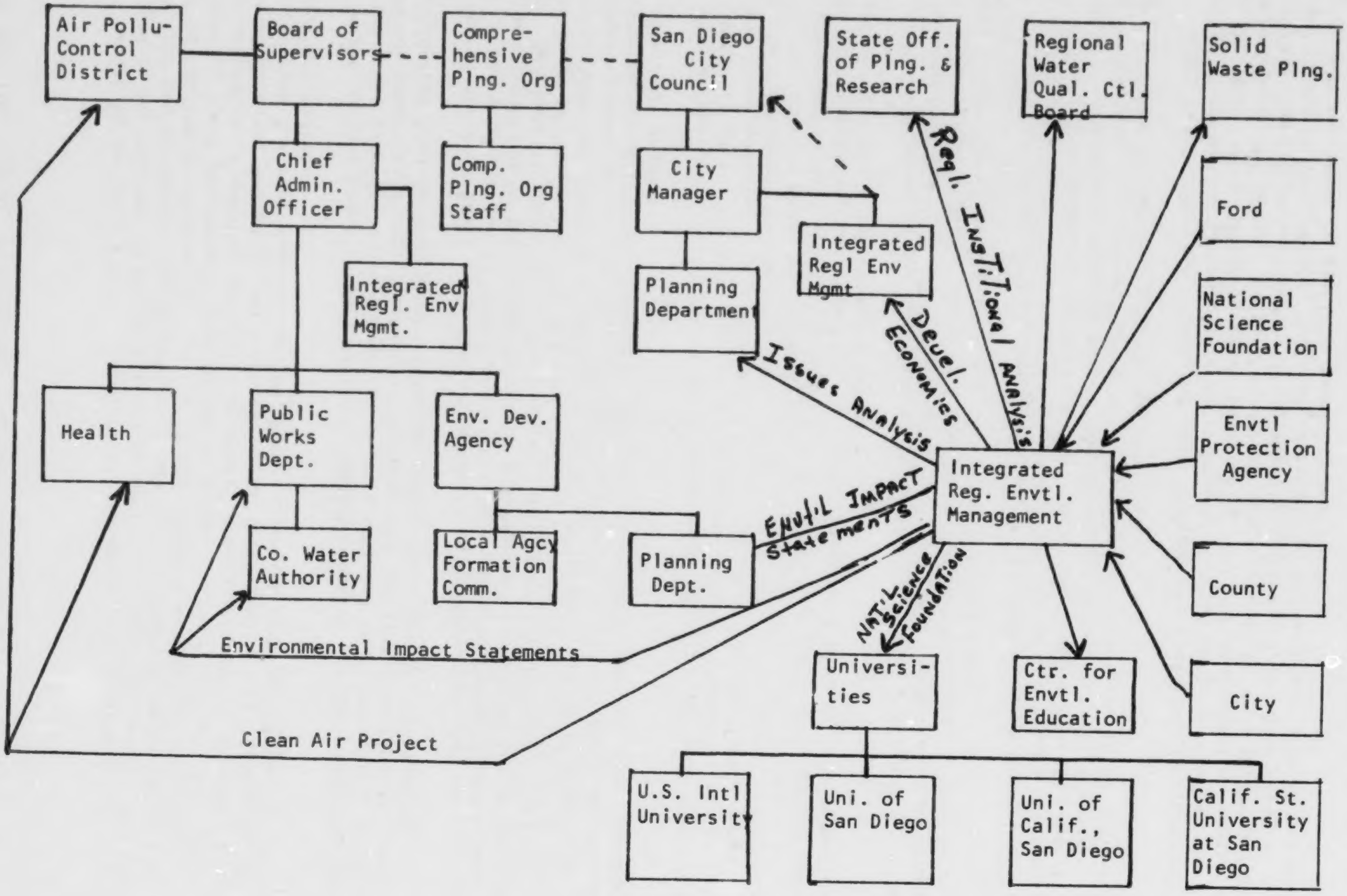
The Regional Center would have a multiplicity of funding sources, including Federal (e.g., Environmental Protection Agency, National Science Foundation), state and local funding, or at least office space and support. The Center would provide environmental issue analysis for the local governments involved.

It is assumed that the Center would carry out, from neutral research standpoint, programs similar to those found to be appropriate in the IREM Project experience. It would also attempt to coordinate the planning and management functions of the various environmentally-related agencies in the region.

## Conclusion

The regional concept for environmental management is not only valid; it is essential. We have finally begun to question the efficacy of institutions that deal with environmental quality at all governmental levels. The resulting analysis leads to the conclusion that a new type of regional institution must be created. The IREM experience is a beginning which yielded significant information about such a regional institutional form. The functions and attributes finally described in the hypothetical model may not be absolutely accurate, but they do begin to approximate a feasible structure for actualizing regional environmental management. It is now up to the practitioners--those involved in local government--to recognize that such new regional organizations are possible and must be brought into being if a rational compatibility is to be found between man and his natural environment.

Figure 3


Air Pollu-Control District
Board of Supervisors
Compre-hensive Plng. Org
San Diego City Council
State Off. of Plng. & Research
Regional Water Qual. Ctl. Board
Solid Waste Plng.
Chief Admin. Officer
Comp. Plng. Org Staff
City Manager
Integrated Regl Env Mgmt
Ford
Integrated Regl. Env Mgmt.
Planning Department
National Science Foundation
Health
Public Works Dept.
Env. Dev. Agency
Envtl Protection Agency
Integrated Reg. Envtl. Management
Co. Water Authority
Local Agcy Formation Comm.
Planning Dept.
County
Universi-ties
Ctr. for Envtl. Education
City
U.S. Intl University
Uni. of San Diego
Uni. of Calif., San Diego
Calif. St. University at San Diego
Regl. Institional Analysis
Devel. Economics
Issues Analysis
Envt'l Impact Statements
Nat'l Science Foundation
Environmental Impact Statements
Clean Air Project

# PREFACE TO: IV. LOCAL STRATEGIES FOR MANAGING THE ENVIRONMENT

A recurring question asked by local public managers is what strategies should be employed to improve environmental quality or avoid environmental crises. For our purposes, strategies are defined as actions taken by governmental bodies which are designed to improve or enhance the quality of the physical and social environment. Traditionally, local governments have relied on either land use and building regulations or provision of capital facilities as their primary strategies. However, a combination of factors, including the inadequacies of these traditional strategies and citizen pressure for environmental action, have led to the development and use of many "new" strategies.

In the opening piece in this section, "Decision-Making for Environmental Quality," Peter House provides a broad overview of environmental decision-making, stressing the need for those decisions to reflect long range and comprehensive considerations. The most logical tool to incorporate these concerns, House argues, is planning.

One of the most basic tools for implementing a comprehensive plan is land use control. A study of the use of land use controls as a means of improving environmental quality was conducted by the Center for Urban and Regional Studies at the University of North Carolina at Chapel Hill. The next article. "Land Use Planning: The Cornerstone of Local Environmental Planning and Control," describes three innovative approaches to land use planning discussed in the study. These are: addition of an environmental element to the planning program; development of an environmental information system as input into environmental decision-making; and creation of a "guidance system planning" process.

When a comprehensive framework for environmental concerns has been developed, new projects can be evaluated by the criteria set out in that framework. In the third selection, "Environmental Impact Statements: More Myth than Reality," Lyle Sumek reviews the development of the procedural requirements for environmental impact statements at the federal, state and local levels. He argues that present attempts to change governmental decision-making to accomodate environmental considerations are fraught with weaknesses. Consequently, the impact assessment process is of questionable merit unless basic improvements are made.

In the following selection, "Federal Power to Protect the Environment," Albert Rosenthal examines the range of actions which government can use to gain compliance with environmental standards from direct regulation (e.g., licensing, financial incentives) to the use of purchasing power and private litigation.

The development of effluent charge systems as a strategy for achieving environmental quality standards is analyzed in more detail in the next article, "Strategies for Environmental Management," by Allen Kneese. Using the example of water quality management, he advocates a charge system that would not only place the financial burden for clean-up on those polluting the water, but also serve as an economic incentive to change the process causing the pollution.

In the final selection, "Emerging Legal Strategies: Judicial Intervention," Joseph Sax looks at citizen-initiated environmental litigation as a means of overcoming the inability of administrative agencies to consider ecological perspectives in the management of natural resources. He stresses the need to move environmental decision-making into an open forum. Since the legislative and/or administrative process has failed in this regard, judicial intervention has become a significant device to insure citizen input on specific community decisions.

# DECISION-MAKING FOR ENVIRONMENTAL QUALITY

Peter W. House*

## Introduction

Rather than assume the initiative, our society tends to react passively to environmental problems. Pollution is treated as a problem to be corrected not avoided. The instinct is for each Federal, State or local agency to treat individual environmental problems as separate entities and to concentrate on short-range crises rather than long-range trends. This approach is inefficient, not only because of its tendency to duplicate efforts, but also because it ignores the fact that pollution abatement problems are long term, intertwined and mutually dependent. One problem cannot be attacked without having a short- or long-range impact on several others.

This paper will consider the two related concepts of comprehensive planning and long-range planning as they relate to environmental efforts. Comprehensive decision-making is concerned not only with the local impact of decisions but also with the effects of a policy decision throughout the entire system. Long-range decision-making takes into account the full time frame necessary for the total significant impact of a decision to be felt.

These two concepts are not uniformly implemented by all levels of decision-makers. For example, individual governmental departments or private firms tend to be primarily interested in their own survival or growth. The competition at these levels is, by its very nature, not conducive to cooperative, comprehensive planning. The decision maker at a higher policy level does, however, have an interest in cooperation since his main strategy is to maximize the quality of of life of his constituency. His interest is in getting agencies to work together to improve (at least marginally) the conditions of life in the area. While social strategies ought to be judged in terms of long-run quality-of-life measurements, such measurements and goal statements are not universally agreed upon, nor are the sacrifices that the goals may require acceptable to all.

Since most of the severe pollution problems are associated with urban areas, efforts at comprehensive planning and at avoiding detrimental side effects from environmental correction actions are complicated by the complex and dynamic nature of urban existence. Consequently, this paper will begin by discussing the effectiveness of existing pollutant-oriented decision-making as contrasted with a more system-wide or "holistic" approach. The second section provides a brief overview of the historical development of both urban areas and urban theory, presenting those areas as dynamic systems and illustrating the impact which prevailing urban theory has upon the environmental decision-making process. Urban environmental planning is the focus of the third section, reflecting the earlier discussion of decision making and the urban theory. Finally, the problem of planning in a rapidly changing environment is discussed from the decision-maker's viewpoint.

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## I. Framework for Decision-making

### The Comprehensive Approach

Decision-making in environmental matters must be done with an overview of the system-wide application of each decision -- a holistic approach. This is made obvious by two factors: the nature of the pollution process and the cumulative impact that urbanization, population growth and economic development have on pollution levels.

The pollution/natural cleansing process in the environment reaches a critical breakdown point (in lakes the process is called eutrification) when the natural system is overloaded with more waste matter than can be absorbed and recycled. When this happens each individual pollutant may augment the damage caused by other pollutants and thus compound the damage to the system as a whole. To be most effective, therefore, the environmental decision-making must concern itself with the sources and interactions of all forms of pollution rather than simply treating each pollutant as a separate problem.

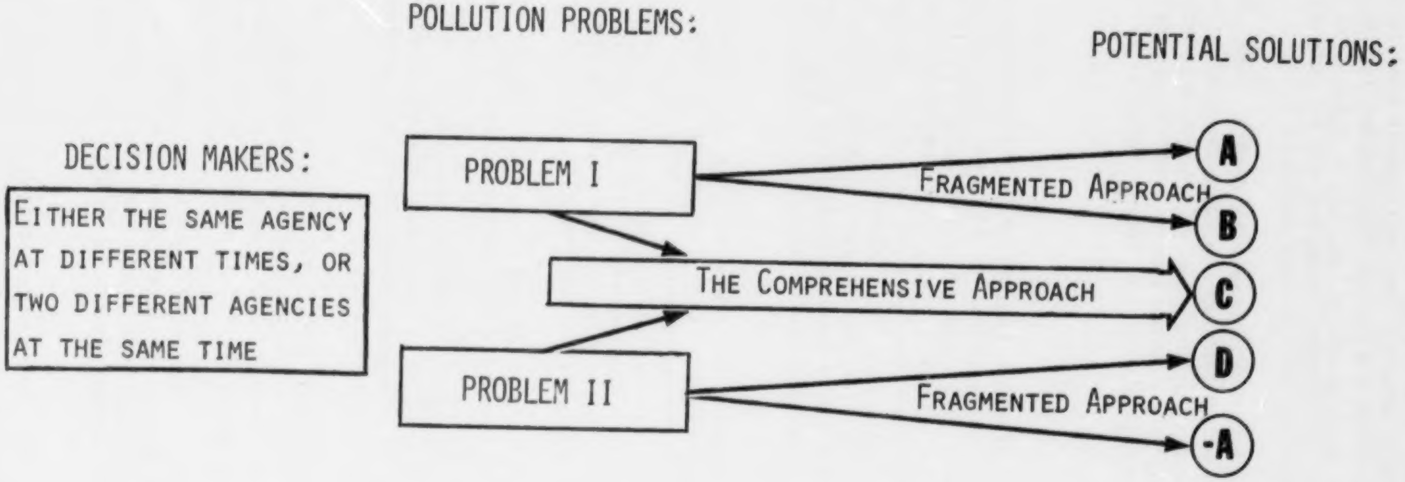
Pollution is more a function of overall density than of the concentration of any specific polluting agent (excepting, of course, agents of extreme toxicity). Since the volume of pollution generally depends on the concentration of people and industry, large cities, where such concentrations exist, are a major focus of environmental efforts.

The second factor encouraging a more comprehensive system-wide approach to environmental decision-making involves the dynamic and cumulative effect of population levels, economic growth and urbanization on pollution trends. A growth in any of these three factors can result in an even larger proportional growth in pollution. Consequently, attempts to curb pollution should recognize the complex, dynamic interactions between economic and demographic factors that add to environmental problems.[1] Prior to discussing the urban situation, however, it is necessary to investigate the decision-making apparatus itself.

The decision-making activities of the Federal, regional and local environmental commissions are often notable for their reactive tenor. They "react" to specific pollution crises or polluting agents with action decisions intended to alleviate the crisis while minimizing their disruptive impact on existing institutions. On the other hand, the original mandate given the Environmental Protection Agency and the Council on Environmental Quality was to look at the environment from a comprehensive or holistic point of view. The National Environmental Policy Act of 1969 authorizes and directs that all agencies of the Federal Government shall utilize an interdisciplinary approach to assess every major program, project or piece of legislation which might have a significant environment impact.

The differences between situation-oriented decision making and systems-oriented decision making are illustrated in Figure I. This illustration demonstrates both the short- and the long-range effects of these two types of decision making. In the short run (i.e., situation 1 and 2 arrive simultaneously), situation-oriented planning treats each problem (in this case a polluting agent) as a separate entity. As such, a duplication of efforts may result, or two programs might be working against each other. A comprehensive approach could avoid such wasted effort by treating each situation as part of a larger structure, defining the relationship between situations, and finding common solutions to multiple problems. In the long run, the holistic approach might avoid the possibility of the solution to one problem creating or complicating other problems.

FIGURE I
COMPREHENSIVE VS. FRAGMENTED DECISION-MAKING


POLLUTION PROBLEMS:
POTENTIAL SOLUTIONS:
DECISION MAKERS:
EITHER THE SAME AGENCY AT DIFFERENT TIMES, OR TWO DIFFERENT AGENCIES AT THE SAME TIME
PROBLEM I
PROBLEM II
FRAGMENTED APPROACH
THE COMPREHENSIVE APPROACH
FRAGMENTED APPROACH
A
B
C
D
-A

A COMPREHENSIVE APPROACH TO DECISION-MAKING LOOKS TO FINDING THE SOLUTION WHICH WILL HAVE THE LEAST NEGATIVE (OR MOST POSITIVE) AFFECTS ON THE ENTIRE SYSTEM. SOLUTIONS WHICH WORK AGAINST OTHER SOLUTIONS (A,-A) ARE IDENTIFIED AND AVOIDED.

In general, this decision process includes: (1) perception of the environment, (2) definition of the purpose of the changes one wishes to effect in the environment, and (3) design of the acts whereby the environment will be altered. Perception of a problem or a situation in need of an improvement is the first step and is a function of the individual's, group's, or society's prevailing value system. It is only in terms of such a value system that judgments can be made as to the nature of the situation and the immediacy of the need for action.

If planning is viewed as simply a problem-solving device, then the emphasis will be on changing the environment while leaving the value system untouched. If, on the other hand, planning is viewed as a continuous, long-range organization of progress throughout the environment, it is necessary to consider changes in the value system as well as the environment to keep the two in harmony.

## Long-Range Planning

Given the extreme complexity of those factors which affect environmental quality and the dynamic changes constantly being introducted into the system by social and technological developments, accurate long-range planning is becoming an increasingly difficult task. But, at the same time, it is becoming even more necessary. A century or more in the past when changes were less radical and occurred more slowly a simple extrapolation based on then-prevailing patterns could be made by planners - with a high degree of confidence. Today, however, major social and technological changes occur with such rapidity that long-range plans are made only with a high degree of uncertainty regarding their relevance in terms of distant future conditions.[2]

This uncertainty is being lessened to some extent by the increasing power of our society to mold the future. Governmental decision-makers are becoming increasingly conscious of this power to control the future. In some areas environmental concerns (for example, the shape of transportation, water quality and energy production and consumption) are being committed decades into the future. Such extensive, long-range planning efforts to mold the future require a continuous, consistent and cooperative pursuit on the part of the decision makers involved.

Such consistent pursuit of a long-range goal may give rise to serious conflicts of future interests with the interests that motivate the original plan. In periods of rapid change, contemporary planners are locking future citizens into forms which are being dictated by present, not future, interests. This "imperialism" on the part of contemporary planners requires that they make every effort to consider future evolving interests as they create their plans, and to somehow make the plan sensitive to evolving interest patterns.

As if such considerations were not sufficient to overwhelm most long-range planning, it should be remembered that all of this interest-weighing is taking place within the context of the political system. This system imposes severe constraints on the planning process. In cases where the future condition of a system is poorly defined, the tendency of the government is to adopt a "wait-and-see" attitude while the situation ripens. Thus, a problem may be allowed to develop into a crisis before any remedial action is taken, and the long-range planner is wasting his breath if he cannot support his warnings with proof that the problem in question will definitely damage the interests of a significant socio-political grouping unless acted upon immediately.

Another problem imposed on the long-range planning process by our political system is the tendency of elected officials to over-promise and under-deliver. This proclivity has jaded the public and made them skeptical of any long-term analysis coming from governmental sources. As a result, expecially in the environmental area, people are reluctant to make present sacrifices for future benefits.

2. The Urban Phenomenon -- The Development of a Frame of Reference

As mentioned earlier, urban areas, with their high concentration of people, transportation facilities and industry, have been a major focus of pollution control efforts. Here, too, the efforts to control the various types of pollutants have great and often unexpected influences over the quality of life available to the majority of our citizens.

It is beneficial to the urban environmental manager to have an understanding of the popular theories of urban growth and how these theories are evolving -- not only to improve his understanding of the development of urban areas, but also to develop an appreciation of how the planner conceives of urban growth. For these reasons, the following section will consider the development of cities and of urban theory.

Explanations of why cities are located in particular places have generally divided into two theories: the central place theory and the "break-in-transportation" theory. The central place theory views cities as regional service centers which provide goods and services for the agricultural hinterland. The specific locus of these cities is dependent on the topography of the region approaching a central position as the terrain becomes more uniform.

The "break-in-transportation" theory is quite similar, relating the location of cities to points in the transportation system which require a change in the mode of travel, e.g., land to water, road to rail, etc. These places, referred to as "break-of-bulk locations" often grew where it was necessary to do the physical work of loading and unloading cargo. They became not merely a meeting of transportation modes but also served as centers for the processing of various goods.[3] Numerous other reasons have been given for urban locations, including political considerations, religious factors, and so forth.

Moving from analyses of urban location to urban development, a comprehensive analysis of city growth stages is presented by Wilbur Thompson's four stages of urban growth. These stages are: (1) the town is largely built around a single industry or firm; (2) the "company town," if the industry or plant is successful, grows to include other industries which either handle some phase of the manufacturing process of the original firm or require the output of the parent firm; (3) the local economy begins to expand and to supply its own local needs through other industries; (4) the city becomes the controlling node of a group of cities and now exports not only the goods supplied by the original firm and its later symbiants, but also exports services to the surrounding cities which are still too small to support their own.[4]

It is important to note that each of these stages of industrial-commercial growth has shaped the character and form of urban areas. Decisions made by present-day decision-makers should take into consideration that their locale is only at a point in its development and should not regard the present as a constant.

The urban pattern and its concurrent theoretical descriptions can be viewed as having progressed through four states: (1) the clear-cut rural-urban dichotomy; (2) the development of cities with identified hinterlands, where both areas are still clearly distinguishable; (3) the development of the metropolitan area where the city fades gradually into the rural countryside; and (4) the growth of large numbers of multiple nuclei resulting in no clear city or rural distinction in the metropolitan area. The growth and development of urban land forms thus follows an observable pattern. This growth pattern determines the distribution of land uses within the city itself, and hence the impact, both localized and regional, of the city upon its natural environment. (See Figure 2)

Ignoring urban dynamics has led to the concentration of pollution-control efforts on the immediate symptoms of the problem. Many such efforts are now, or eventually will prove to be, ineffective in the long run. Ignoring the complexity of urban forces has resulted in pollution-alleviation efforts in one sector which have either aggravated problems in another sector, or have created new and undesirable forces.

For example, the attack on air pollution has been conducted by a variety of agencies each with responsibility over some aspect of air quality control. The lack of a holistic approach to urban air quality efforts can have a far-reaching impact on the rest of the urban environment. For instance, added mass transit facilities, if electrically powered, place increased strains on power generation stations during peak-use hours. This can cause power companies to employ older generators or less clean fuels thus, again, adding to air pollution. The specific examples are almost endless.[5]

A condition similar to the air quality example exists in the area of urban solid waste treatment. The solid wastes which are of greatest concern to urban areas are municipal refuse, industrial wastes, and the solid residue remaining after volume reduction operations on liquid and solid wastes.

Of an estimated national annual solid waste total of 3.6 billion tons, almost 200 million tons are household waste or 4.3 pounds per person, per day. The collection and disposal of municipal and industrial wastes cost approximately $4.5 billion per year As a result of our improving standard of living and the trend toward disposal products, it is estimated that each of us will be discarding eight pounds of solid waste a day by 1980.

Here again is an example of the interrelatedness of urban environmental problems. Refuse collection is far more difficult in the central city because of traffic and housing density and accessibility problems. The same automobile traffic problem which contributes substantially to air pollution impairs the freedom of refuse vehicles to move effectively along their routes. Finally, incinerators currently in use represent another "problem" to the central city principally in their inadequacies and in their contribution to air pollution.

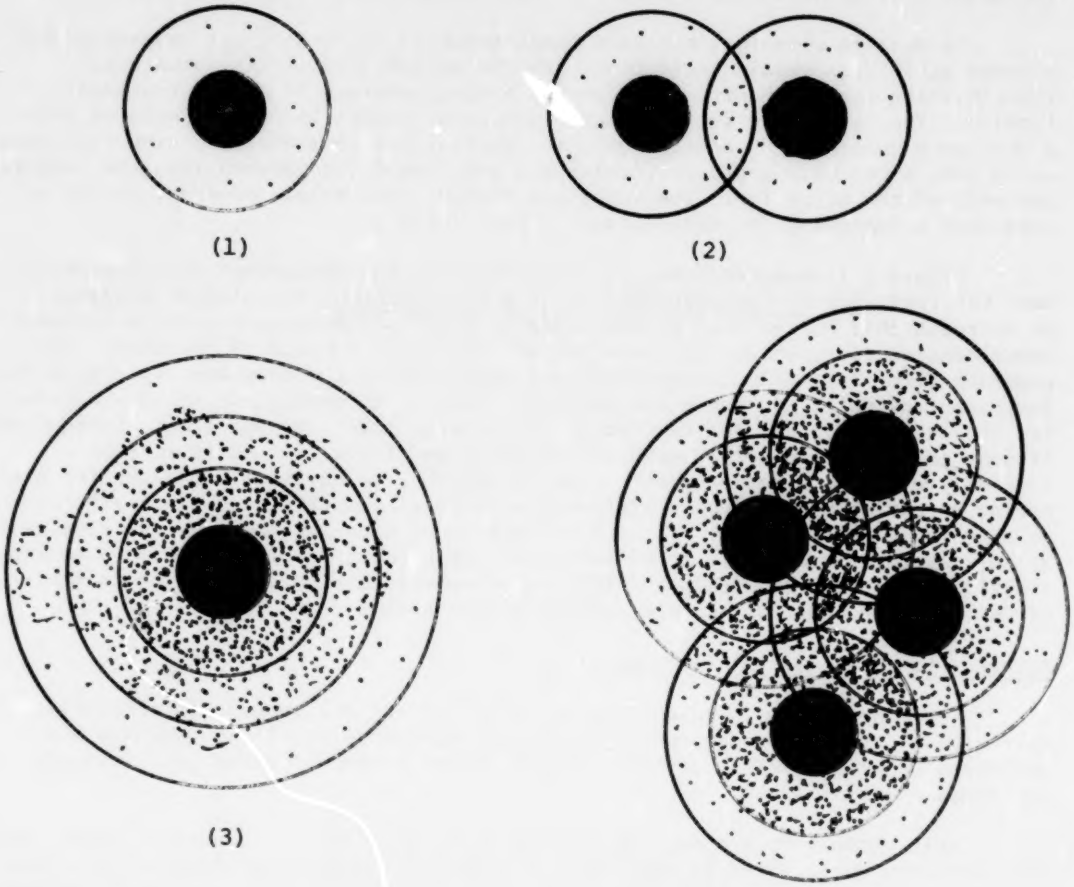
As a result of the uncoordinated effort, pure improvement is rare. Instead, improvement in one area often causes deterioration in another. More research is needed to coordinate efforts and obtain the most desirable long-term results with the most efficient methodology. Less work, in a relative sense, should be done to "band-aid" the problem.

### 3. Comprehensive Long-Range Planning in a Changing World

Planning is a process of projection under uncertainty. The projections are based upon present data and knowledge with continued monitoring and replanning as necessitated by a changing environment. The planning process should be dynamic in application.

The purpose of the environmentally conscious planner is to develop a methodology that avoids conditions which would significantly damage the "quality of life" as perceived by this and future generations.

FIGURE 2.



(1) (2)

(3) (4)

There are three characteristics of effective planning: First, plans are directed toward creating new norms and values which will be more conducive to environmental harmony. Second, goals are set with a view toward their feasibility given the available resources. Third, administrative capabilities are created to implement desired strategies in terms of the priorities, schedules, etc.

In dynamic planning, periodic reassessments are carried out to assure that planned activities remain consistent with the evolving facts (the data base). Through these reassessments, the planning process evolves in a self-regulatory fashion. The next stage in the process sounds as though it were formulated with a "buzzword generator." Nonetheless, an improved environmental planning technique would take a holistic approach involving a multi-media, comprehensive, and long-term analysis of the situation. The tools and methods that exist, however, permit no more than a beginning for such a task. (See Figure 3)

Figure 3 is adapted from the International City Management Associations's book entitled, Principles and Practice of Urban Planning. The diagram suggests an approach that can be used by the state or local planners to prepare a standard comprehensive plan, which considers the environmental impacts of the plan. The comprehensive plan, if well-conceived and supported by the populace, is a powerful instrument of policy guidance and control. Under such conditions it sets boundaries for the local citizenry and developers as the area moves through time. Concomitantly, it sets goals for the policy maker to maintain and foster, if he is to remain popularly elected. Research is currently underway to devise a technique for preparing an environmental impact statement on a total comprehensive plan rather than on each individual project. If such a technique can be implemented, the synergistic, as well as the direct, effects of decisions can be more readily taken into consideration. Several efforts within the EPA and elsewhere have begun research in the areas of designing and perfecting such analytical techniques.

## Barriers to Environmental Planning

There are several reasons why planning for the environment is generally not carried out on either a comprehensive or long-range basis. In no case are the following general rules suggested as exhaustive but they do serve to illustrate the range of possiblities.

(A) Those who are professionally concerned with environmental issues, as well as those whose interest grows out of avocation, seem automatically to assume that everyone perceives the environment as they do. Pollution prevention, however, is not without cost, and those who must pay the cost are often less than enthusiastic about the crusade. The industry or farmer which faces large capital costs to improve environmental practices is seldom an environmentalist. The list of such disenchanteds is likely to be quite long and makes up a considerable backwash for the environmental movement. This potential opposition helps to define the constituency of a policy maker. Not only does it make a difference who brings ideas to the decision-maker and how ideas are transmitted to his constituency (and the feedback to him) but the opponents' strength and position will also help shape policy.

(B) As almost everyone who deals with large numbers of people knows, the training one receives in a professional discipline colors one's whole outlook and helps determine the way one carries out analysis and develops policy suggestions. The following typology is suggestive of this phenomenon:

| Institution social role or cultural subsystem | Decision method | Meaning--goal |
|---|---|---|
| Economics | Calculation of costs-benefits | Maximize benefits |
| Religion | Contemplation | Spiritual truth |
| Philosophy | Logic, reason | Rational truth |
| Science | Experiment | Empirical truth |
| Ecology | Field research | Fitness, adaptation |
| Arts | Design | Expressive form, beauty |
| Technology | Invention, test | Efficiency |
| Jurisprudence | Hear evidence | Justice |
| Politics | Bargain, compromise | Equity |
| Law | Social need | Rights, duties, order |
| Personal | Integrative, sacrifice | Solidarity, love |
| Medicine | Diagnosis | Health |

(C) The frame-of-reference of the decision-maker is a further extension of his professional prejudice. Not only does the information for policy alternatives get prepared from specific policy viewpoints, but the decision-maker himself also has a set of specialty blinders. This feature of the power chain influences the type of people the decision-maker is apt to have as part of his advisory staff and defines the filter through which the information is processed.

(D) The discipline of the decision-maker can be tempered if he is the type of leader who is willing and able to assimilate new information. This feature of the leader's personality requires the endurance and stamina to carry forward the new information to an action stage.

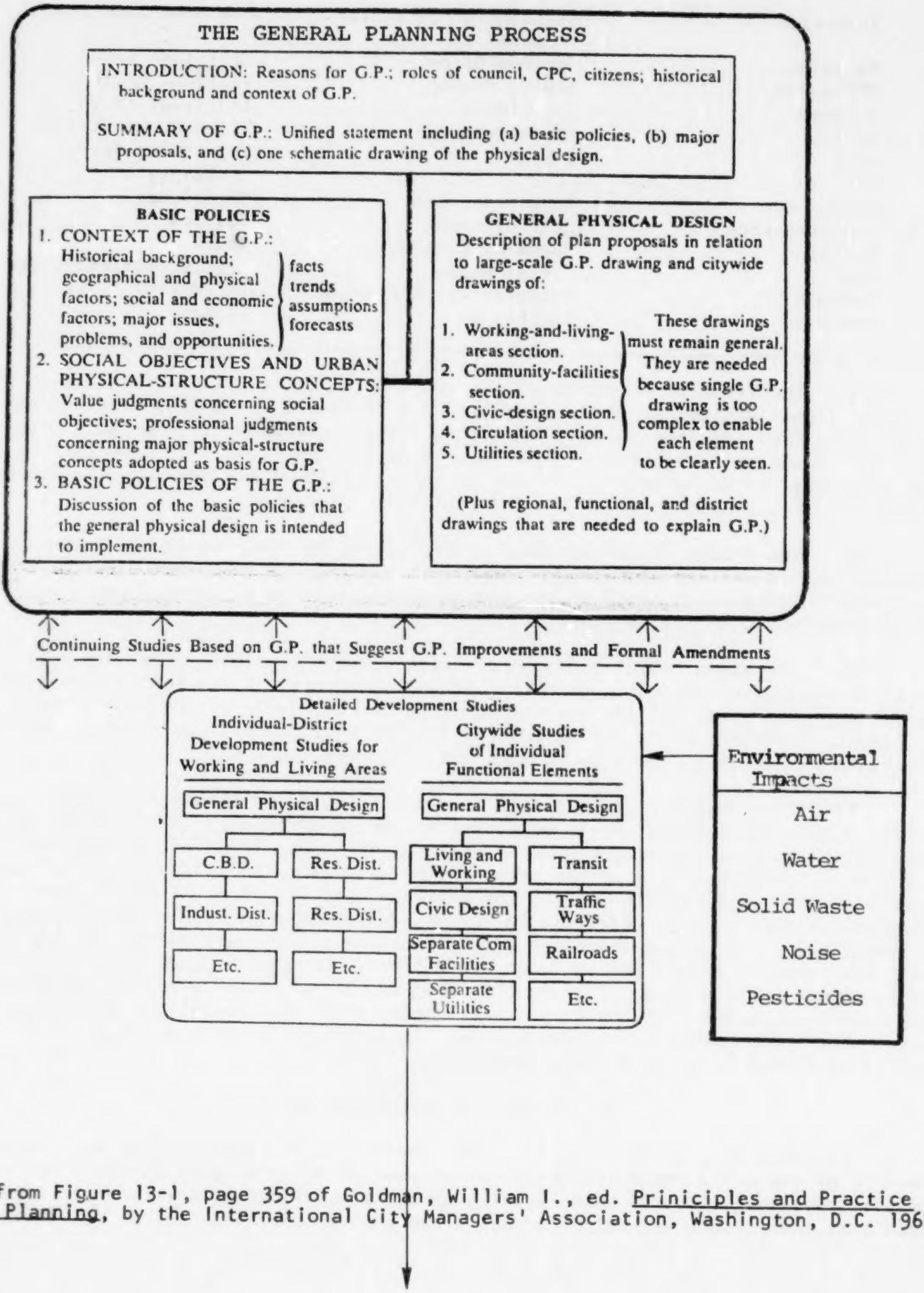
(E) The above features of the decision-maker all point to the very real nature of the day-to-day world of policy making. Activity at the top is always fierce and in constant motion. It is the world of NOW, and the time span beyond his purview is relegated to taking care of itself. All of the reward and threat of our system is structured to support this mode of operation.[7]

(F) The concept of time itself constrains the decision-maker The most receptive time for information is at a similar period of crisis. All problems at these periods are immediate and require generous mixtures of insight and action. As time goes on, more and more of the organization is clothed in laws and regulations. These were usually formulated during the period of crisis. Both of these time-oriented features tend to result in policy proclamations which are oriented toward the immediate: the people who responded best to the crises surrounding the decision-maker are normally either titularly or figuratively elevated to more powerful positions. Since their reward is the result of an expertise in short-run policy analysis, they usually continue this tendency. The agency, with its regulations and rules, becomes similarly oriented. In short, there is little in present day reality to facilitate either long-run or comprehensive analysis.

## 4. The Environmental Analyst

The contention of this paper is that there must be comprehensive and long-run planning of the environment if the decision-maker is to promulgate policy which will actually have the effect of both cleaning up and preserving the environment. It is hoped that the cursory excursion through urban theory (and history) has convinced

FIGURE 3.*



THE GENERAL PLANNING PROCESS
Continuing Studies Based on G.P. that Suggest G.P. Improvements and Formal Amendments
Detailed Development Studies
Individual-District Development Studies for Working and Living Areas
Citywide Studies of Individual Functional Elements
General Physical Design
C.B.D.
Res. Dist.
Indust. Dist.
Res. Dist.
Etc.
Etc.
General Physical Design
Living and Working
Transit
Civic Design
Traffic Ways
Separate Com Facilities
Railroads
Separate Utilities
Etc.
Environmental Impacts
Air
Water
Solid Waste
Noise
Pesticides

INTRODUCTION: Reasons for G.P.; roles of council, CPC, citizens; historical background and context of G.P.

SUMMARY OF G.P.: Unified statement including (a) basic policies, (b) major proposals, and (c) one schematic drawing of the physical design.

**BASIC POLICIES**

1. CONTEXT OF THE G.P.: Historical background; geographical and physical factors; social and economic factors; major issues, problems, and opportunities. } facts, trends, assumptions, forecasts
2. SOCIAL OBJECTIVES AND URBAN PHYSICAL-STRUCTURE CONCEPTS: Value judgments concerning social objectives; professional judgments concerning major physical-structure concepts adopted as basis for G.P.
3. BASIC POLICIES OF THE G.P.: Discussion of the basic policies that the general physical design is intended to implement.

**GENERAL PHYSICAL DESIGN**

Description of plan proposals in relation to large-scale G.P. drawing and citywide drawings of:

1. Working-and-living-areas section.
2. Community-facilities section.
3. Civic-design section.
4. Circulation section.
5. Utilities section.

} These drawings must remain general. They are needed because single G.P. drawing is too complex to enable each element to be clearly seen.

(Plus regional, functional, and district drawings that are needed to explain G.P.)

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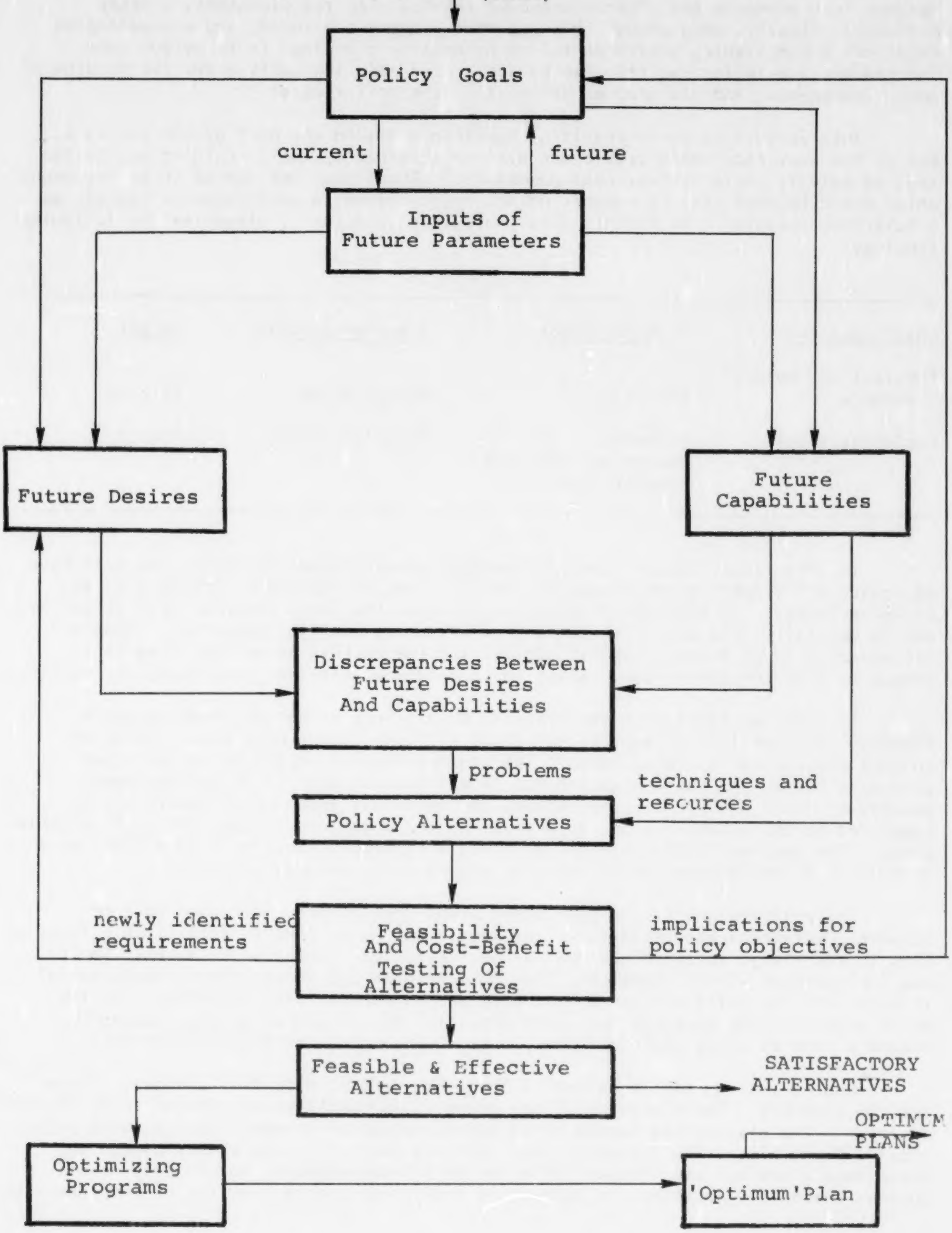
*Adopted from Figure 13-1, page 359 of Goldman, William I., ed. Priniciples and Practice of Urban Planning, by the International City Managers' Association, Washington, D.C. 1968.

FIGURE 3. (CONT.)


Policy Goals
current
future
Inputs of Future Parameters
Future Desires
Future Capabilities
Discrepancies Between Future Desires And Capabilities
problems
techniques and resources
Policy Alternatives
newly identified requirements
Feasibility And Cost-Benefit Testing Of Alternatives
implications for policy objectives
Feasible & Effective Alternatives
SATISFACTORY ALTERNATIVES
OPTIMUM PLANS
Optimizing Programs
'Optimum'Plan

the reader that it is a dynamic and, in some senses, living system which is apt to respond in a perverse and often unexpected fashion when fed piecemeal, stopgap measures. Finally, even though this argument appears convincing and methodologies exist for accomplishing environmental comprehensive planning, it is seldom done. The reasons are legion but they can be summarized most logically under the heading of poor, inadequate, and misinformed advisors to the policy-maker.

This feature is not a result of capriciousness on the part of the advisors, but of the fact that these people are also constrained by their training and by the need to satisfy their professional community.[8] There does not appear to be any group which would be dedicated to supporting the policy-maker in environmental issues, as a full-time vocation. To further illustrate this void let us visualize the following typology:

| Basic research | Transfer agent | Transfer process | Output |
|---|---|---|---|
| Physical and natural science | Engineer | Market place | Product |
| Social sciences | Planning<br>Operations research<br>Popularizing | Political arena | Policy |

To effectively support the policy-maker on environmental issues, we will have to create and support a new scientific layer in the professional community of the social sciences. In the natural-physical sciences the basic research that is carried out is generally of a nature which is unsatisfactory for implementation. Generally the research is of a more esoteric quality and the usefulness of the research to groups outside the particular discipline is seldom a criterion in judging its quality.

In order to facilitate the transfer of a select number of these research findings, the portions of society concerned with production have been willing to support a group called "engineers." The engineers are accepted by not only the producers but by the basic researchers. The situation results in the engineers developing their own professional ethic. Because this group of professionals is supported by the producers, the objectives of the engineers reflect the needs of this group. The engineer prides himself on being a problem solver; he seldom looks at a problem from the perspective of how the objective can be accomplished.

The policy-maker in the government arena really needs this same sort of support. Unfortunately, numbers of the people who would like to fulfill this function find it too risky, in a professional sense, to become tainted with "merely" implementing somebody else's research. Those who bridged the chasm between basic social research and the political arena have been called popularizers, especially by the basic scientist who does not see the translation of his jargon to more generally readable form as being useful, in the sense of advancing the state-of-the-art.

Another, more readily definable group has attempted to fill the gap. These are the planners. Their profession has grown up as complimentary in the sense of the engineer. The planner has tended to define his areas of interest in line with political and administrative jurisdictions. Unfortunately, for the policy community, these people are not usually available for day-to-day support, nor do they usually possess the skills necessary to handle the analytical chores required by comprehensive, long-range policy-making. This gap is being rapidly filled by still another contingency--the operations researcher.

The purpose of this sorté through the search for a legitimized policy scientist, or environmental analyst, is to suggest that it is only when such a profession is created that the decision maker will have the impetus to take the future into consideration. The environmental analyst will have this long-range viewpoint because of the training provided in his discipline, and his logic will be reinforced by his peers. The decision maker will have the confidence (rightly or otherwise) to meld these factors into his policies, or his advisors will do it for him and attest to the soundness of the practice. It is not, in short, logical to assume that the decision maker--who is a successful political animal--will change his habit pattern to a less certain strategy. Therefore, the change will have to come from his advisors, who concomitantly will have to receive support and encouragement from either the social scientists or from their own peer groups.

In conclusion, comprehensive long-range planning is both vital and inevitable. Vital because of the opportunities missed and the dangers risked by any other approach to environmental planning. Inevitable because the complex dynamics of modern socio-political and economic structures cannot be handled in any other way. Such an approach to planning will, however, breed a whole new set of problems, some of which have been mentioned above. Anticipating these problems and encouraging the trend toward long-range comprehensive planning will improve both the efficiency of policy actions in the short run and the possibilities of obtaining the desired future in the long run.

# Notes

[1] "Forecasting", Environmental Quality, The Third Annual Report of the Conference on Environmental Quality, August '72, pp. 72-73.

[2] See also Leonard J. Duhl, "Planning and Predicting", in Daniel Bell (editor), Toward the Year 2000: Work in Progress, (American Academy of Arts and Sciences, 1968), pp. 147-156.

[3] Chas. Horton Cooley, Sociological Theory and Research (NY: HOH, 1930), pp. 17-118.

[4] Wilbur R. Thompson, A Preface to Urban Economics, published for Resources for the Future, Inc., by the Johns Hopkins Press, Baltimore, 1969, pp. 15-16.

[5] See also Harvey S. Perloff, "A Framework for Dealing With the Urban Environment", introductory statement in Perloff (editor), The Quality of the Urban Environment, (Washington, D. C., Resources for the Future, Inc., 1969), p. 21.

[6] Farness, Stanford S. "Resources Planning versus Regional Planning", Future Environments of North America.

[7] Perusal of college catalogues shows that, for those who majored in the areas of law, social science, business, public administration and liberal arts more than a decade ago, few had any training in analytical subjects and probably none in computer sciences. This means that a large portion of our policy leaders and their advisors are conversant with modern decision-making tools only to the extent that they have educated themselves. The subsequent fear of the new and unknown is a serious impediment to change.

# LAND USE PLANNING: THE CORNERSTONE OF LOCAL ENVIRONMENTAL PLANNING AND CONTROL

Edward J. Kaiser, Karl D. Elfers, Sidney Cohn,
Peggy A. Reichert, Maynard M. Hufschmidt, and
Raymond E. Stanland, Jr.*

Land use planning viewed within the framework of the overall urban planning process is only that sector of planning concerned with the location and intensity of various urban activities. Yet, insofar as land use creates the physical setting for economic and social system activities and is the physical expression of these systems within the environment, its impact is complex and far reaching. Moreover, land use planning should serve as the basis for other physical development planning: open space, transportation, public utilities, public facilities, etc.

Land use decisions, once enacted into physical development, remain within the urban system for many years. Unless massive urban and suburban renewal every few years is to become the rule of thumb (as in fact some urban observers have proclaimed to be the only option), land use decisions must be made with an eye to placing all objectives within a comprehensive and systematic framework.

## The Limits of Land Use Planning

Pollution, which may be viewed as the residual of the overall urban production process, may be abated in three basic ways: through modification of residuals after production (e.g., sewage treatment), through modification of the production process itself to reduce the amount or change the character of the residuals generated (e.g, altering the basic industrial process), or through utilization of the assimilative capacity of the environment to reduce the degradational impact of the residuals generated (e.g., locating industries along the river into which they discharge at sufficient intervals to allow the river to "recover" or assimilate the residuals before receiving another load). The latter approach, utilizing the assimilative capacity, involves land use planning in its generic sense. Nevertheless, some types of environmental problems are of such character, intensity, or common proliferation that land use planning cannot cope with them. This is often the case in intensely developed urban areas where land use is not subject to easy change and existing conditions make it impossible to plan within the assimilative capacity constraints. Land use planning as here discussed, therefore, is a means for promoting environmental quality most appropriate to developing urban areas.

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*Excerpted from Promoting Environmental Quality Through Urban Planning and Controls. A research report done at The Center for Urban and Regional Studies, The University of North Carolina at Chapel Hill for the Office of Research and Monitoring Environmental Protection Agency. Excerpts are from a review draft which is subject to revision and should not be quoted in its present form.

## The Evolution of Land Use Planning

The traditional approach to land use planning begins with a projection of future economic growth in the urban area.[1] This projection is based on trends in both the national and regional economy. It reflects the potential of the given urban area to capture a part of this total growth and in some cases the hope of the community to do so as well. Given the projection in amount and type of economic activity, future population is estimated. These two projections are then translated into estimates of future land demand for industrial, commercial, residential, and public activities. Land supply is evaluated according to suitability and capacity for these various activities. The suitability and capacity of a land parcel is defined in terms of its location or accessibility, size, and general physical quality.

The basic assumption of this approach is that economic growth will bring positive benefits to the community and that such growth can be best fostered by designing the land use pattern to maximize accessibility within the system of economic activity. Further related assumptions include 1) an unlimited supply of land suitable for urbanization exists, 2) a city is essentially an economic production unit and should be organized in a manner most efficient for such production and 3) the negative effects of spatially organizing land use according to economic activity criteria can be assuaged through technological solutions after they are discovered, solutions which an economically productive society will be able to afford.

These assumptions began to come under scrutiny in the 1960's when the effect of the emphasis in land use planning on economic system efficiency became more fully disclosed. Pollution in urban areas was high, and the cost of reducing it where it was still possible, through technology alone, was extreme. Many forms of environmental degradation, however, appeared more permanent. For example, rich natural areas and farm lands, long accessible points of amenity to urbanites and necessary ingredients to the American definition of the quality of life, were rapidly disappearing as cities expanded through haphazard suburban sprawl across the rural fringe. Furthermore, the very effectiveness of planning characterized by long range master plans to be implemented primarily through zoning came under question.

The following discussion will present some of the approaches currently being taken on each of three fronts of innovation:

1) in the redefinition of comprehensive planning to incorporate a concern with land use-environmental quality relationships;

2) in the inclusion of environmental system information and evaluation criteria in land use plan and policy development;

3) in the emphasis on implementation and therefore in the creation of a more sophisticated urban planning process - guidance system planning.

## The First Front: The Redefinition of Comprehensive Planning

There are two basic ways in which comprehensive planning is being redefined or reorganized to reflect environmental objectives. The first approach is to add a new sector to the total planning program which will focus specifically on environmental systems in a manner parallel to that of other sector planning such as economic development, social policy, or transportation. The second approach involves a more fundamental realignment of comprehensive planning. Thus, an attempt is made to examine the relationships, both supportive and conflicting, among the objectives of the many urban systems and to develop some resolution among them which will guide planning within the various sectors toward a more coordinated goal set.

The first approach, adding a new sector to comprehensive planning, parallels that taken at the federal level and by many states whereby a separate environmental planning sector or even a separate agency is established.

Huntington, New York, for example, recently created a local environmental protection agency. The agency is involved in the traditional pollution oriented programs related to air, water, solid waste, noise, and pesticides as well as land conservation. In the spring of 1972, the town of Huntington sponsored the design of an environmental planning program for the area by a group of graduate students in the Department of Regional Planning and Landscape Architecture at the University of Pennsylvania.[2] The program involved an inventory of natural systems in the area (land, water, climate, plants, sea, people, and amenity) and from this, areas for protection, remedy and redevelopment were designated and policy actions recommended. To a large degree, the actions proposed for each type of designation were related to questions of land use and development. The extensive data collected by the students, much of which is in map form and the program design itself is now housed within the new Environmental Protection Agency.

The primary formal procedure by which environmental objectives are interjected into the planning and development process is through the requirement for environmental impact statements. Huntington requires environmental impact statements to be submitted on all public development proposals, whether funded at the federal, state, county, or local level, and on industrial use and subdivision requests by private individuals.[3] Agency personnel use the information and codification scheme when they are called upon to comment on the environmental implications of development proposals.

Another example of this approach is Los Angeles. There the Department of City Planning is adding a new sector to the General Plan--"An Environmental Conservation Element."[4] It should be noted that this approach is mandated by the State of California in its Planning and Zoning Law.[5] In California, all cities and counties are required to adopt general plans which must contain nine elements: Land Use, Circulation, Housing, Conservation, Open Space, Seismic Safety, Noise, Scenic Highway, and Safety.

The new component of the General Plan represents a compilation of data from technical reports and interviews with personnel from various city agencies involved in environmental questions. Environmental issues are divided into six categories: air pollution, water quality, noise control, the conservation of land and resources, solid waste disposal and pesticides. The report, while providing the basis for the new element of the General Plan, is also intended to serve several secondary, yet perhaps more critical, functions:[6]

> These include (1) serving as a comprehensive framework through which the multitude of governmental and private agencies, citizen groups, etc. can perceive the interrelationships between various aspects of the environmental problem, (2) providing the specific policy recommendations needed for the formulation of additional standards and legislation pertaining to environmental quality, (3) presenting guidelines for the modification of City

procedures so as to minimize the negative impact of City operations on the environment, and (4) as a general and comprehensive data source for information pertaining to various environmental questions in Los Angeles.

California law now requires that all cities and counties "make a finding that any project they intend to carry out, which may have a significant effect on the environment, is in accord with the conservation element of the general plan."[7]

In the approach exemplified by both Huntington and Los Angeles, environmental objectives are examined somewhat separately from other community objectives. No explicit attempt is made to reassess other community objectives related to social or economic goals which may, by their very nature, frustrate the achievement of environmental quality.

The second approach to redefining comprehensive planning involves a more fundamental realignment of all community objectives in the light of a new awareness of the environmental implications. Environmental quality is viewed as an integral facet of the broader goals related to the "quality of life;" to be defined and approached as a problem requires first an exploration of all community objectives and their long term implications to the environment.

For example, Wayne County, Michigan embarked on a new approach to comprehensive planning in 1970 in which environmental quality was posited as one of the most fundamental issues of urbanization. To a large extent, the redefinition of comprehensive planning for Wayne County has involved a rather complex process of long range goal planning for the area. The data generated through the process is aimed more at redefining the mind set which the public and its decision-makers bring to questions of urbanization to include an understanding of the complex and interdependent eco-system rather than pointing to specific action recommendations.[8] The recommendations included in the volume on environmental quality...while not all are directly related to questions of land use, do exhibit strong implications for land use guidance:[9]

A. Establish an optimum population range for the County so that the total spatial needs of the population can be met.

B. Adopt policies and methods to insure the full range of life style options to all citizens.

C. Program gradual steps to adjust the economy of the County to the optimum of Population "A" above.

D. Urge the transition of energy generation to other than fossil fuel sources.

E. Urge and require recycling of exhaustible materials.

F. Recognize the relationship of taxation and municipal boundary issues to environmental problems and take appropriate steps.

G. Conserve land resources by erosion and sedimentation control ordinances at both municipal and county level.

H. Develop jointly with the Chamber of Commerce and Economic Development Agencies, methods of identifying, reporting

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and coping with non fiscal costs of pollution.

I. Periodically report public and private fiscal cost of pollution.

J. Adopt policies and methods (zoning and/or acquisition as examples) which preserve open land.

K. Urge consumer participation in environmental protection efforts.

The Albuquerque-Bernallillo County Planning Department took a similar approach to redefining comprehensive planning goals. The Department published a discussion of community goals within the context of long term environmental system constraints.[10] The Comprehensive Plan, Metropolitan Environment Framework assesses past and future trends in environmental quality and poses two alternative growth strategies based on two different goal sets to deal with the identified trends. The first option would require more stringent public controls of urban growth aimed at simply modifying the trends in degradation to an accepted degree. The second approach is based on a fundamental alteration of trends to insure optimum long term environmental quality. For example, under "Strategy 1" population growth would be limited to a 3% maximum annual increase whereas under "Strategy 2" population size would be estimated according to a determination, as yet undefined, of the local resource capacity. In terms of land use, "Strategy 1" would require standards for location and control of development rates. Strategy 2 would call for improving land through land development.

These two orientations to the redefinition of comprehensive planning goals represented on the one hand by Huntington and Los Angeles and on the other by Wayne County and Albuquerque differ primarily in purpose. In the case of the first two examples, the intention is to develop an action program to achieve agreed upon environmental objectives such as national standards for air and water quality. The time frame of such planning is thus rather short range. In the second approach, the objective is not so much to develop an immediate action program as it is to develop an understanding of the complex interdependencies among environmental systems and the relationship of urban man to the eco-systems within where he participates.

Actually, these two approaches need not be viewed as mutually exclusive. It may well be that both approaches are necessary and should be undertaken simultaneously.

## The Second Front: The Inclusion of Environmental System Information and Evaluation Criteria in the Land Use Planning Process

Recent approaches to defining an environmental system information base for planning may be viewed as reflecting three general schools of thought. The first focusses on an inventory of the key natural sub-systems in the planning area which pose resource constraints on urban development. The second approach is also based on an inventory of the natural sub-systems but emphasizes their interpretation as interdependent processes in the ecosystem. The third approach also inventories key natural sub-systems but interprets their significance in terms of man's visual perception of the environment. The three approaches, thus, may be termed respectively - a natural system inventory analysis, an eco-system analysis, and a visual landscape analysis.

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Regardless of the approach taken to resource analysis, the information generated may be used at various stages in the planning process; to monitor current environmental trends and predict future conflicts in order to focus planning priorities; to determine the optimal land use allocations from an environmental quality perspective as an input along with other economic and social system demands for land use planning; to determine the environmental impact of alternative plans or policies in order to select the best one; to determine the design of a project once the general alternative has been selected in order to foster the best fit between the demands of urban man and the demands of nature (the assumption here is that to a certain extent, modern urban man's life style is simply not completely harmonious with the demands of the natural environment).

## Natural Systems Inventory Analysis

The primary objective of this type of natural resource inventory is to develop a natural features information base which may be used in the planning process as a rationale for determining optimal space allocations for land use. The central operating principle is that specific features of the natural environment exhibit an intrinsic suitability for some land uses more than for others. Common environmental sub-systems inventoried include geology, pedology (soils), hydrology, meteorology, climatology, plant associations, and fish and wildlife.

At present, there appear to be two fundamentally contrasting objectives: first, to determine environmental constraints to development and second, to protect the environment from development.

The study, The Natural Features of the Washington Metropolitan Area, prepared by the Metropolitan Washington Council of Governments is an example of an inventory conducted to determine environmental constraints to development.[11] The study focusses on seven natural features of the area which impact on development: Geology, Minerals, Elevation, Slope, Soils, Streams and Drainage Basins, Flood Plains, Groundwater, and Woodlands. Woodlands are the only plant associations identified and this is justified on the grounds of aesthetics and amenity, conservation, and direct economic value as a commercial product. Fish and wildlife are not assessed. Those features that are identified were selected because of, and evaluated with respect to, their impact on urbanization. The information is finally synthesized into a "natural features composite." The composite map "shows some of the areas where public policy should reflect the limitations or opportunities /primarily for economic gain/ inherent in the physical environment: areas of shallow depths to bedrock; poor drainage areas; areas having mineral resource potential and areas where landslides, flood plains, and severe slopes occur."[12]

Since the publication of Design with Nature in 1969, the name Ian McHarg has become associated with the second approach to environmental systems analysis emphasizing the protection of natural processes.[13] Hence, McHarg's environmental analysis of the Twin Cities Metropolitan Area shall be described to represent an inventory and analysis of key natural systems for the purpose of their protection.[14]

The list of phenomena thus inventoried are similar to those identified in the Washington study although plant associations and fish and wildlife are given attention here: climate, historical geology, bedrock geology, superficial geology, foundation conditions, economic minerals, physiography, hydrology (surface water and ground water) pedology, plant associations, fish and wildlife, and existing land use.

The major environmental systems inventoried are evaluated in terms of relevance to four land use groups:[15]

> Production. Those land uses related to production from the land. Examples are: agriculture, forestry, wildlife propagation, and mineral extractive industries.
> Protection. Those land uses whose primary purposes are to preserve, protect, and conserve those elements of the natural environment considered to be unique, scarce or vulnerable or constitute a hazard to life and health. Such resources may include erodable slopes, flood plains, and recharge areas.
> Recreation. Those land uses whose primary purposes are to enable the constructive use of leisure time in an active or passive manner.
> Urbanization. Those land uses related to residential, commercial, institutional, and industrial developments.

Attributes of each environmental sub-system are ranked on a scale of 1 to 5, one being most desirable and five being least desirable, for each land use category.

> Using geology as an example: bedrock, flat land on sands and gravels, flatland on drift, sloping land on sands and gravels, sloping land on drift, and alluviam, lake deposits, eskers and kames, are given successively lower values as foundation materials.[16]

Next, relevant natural phenomena and processes are incorporated into suitability classes. A matrix for each environmental sub-system comparing its relevance to the four land use groups is developed.

The matrices are then used to map the intrinsic suitability of each specific land use (e.g., production involves agriculture, forestry, wildlife production and extractive minerals). These maps are combined into four maps of the intrinsic suitability for the four major land uses and finally a single synthesis map is produced. Each prospective land use is ranked in order of relative importance. Ranking could vary according to the objectives of the community. The rank order selected in this case was protection, urbanization, agriculture, active recreation, forestry, and extraction; thus, highest priority was placed on areas designated of natural value.[17]

> A matrix is prepared in which all land uses are listed on each coordinate. Those which were compatible if co-existing are so identified as are those that are incompatible. Mapping proceeds by identifying the category of Protection with the compatible and permitted land uses. Thereafter, all prime urban land not in competition with any other category is mapped. Prime urban is next mapped showing competition with prime Agriculture and prime Recreation. This procedure is followed through the hierarchy of the matrix. The final map reveals not only single intrinsic land uses, but those that are complementary and competitive, in a range of values.

## Ecosystem System Analysis

The second approach to environmental system inventory and analysis differs from the first primarily in the scale of investigation. While the first approach necessarily involves a rather general cut of natural features such as hydrology, pedology, meteorology, and wildlife to be incorporated in the general plan making process, an ecosystem analysis examines the living organisms and their non-living environment found at the project site level.

Although few studies of this type have actually been conducted, the ecological analysis model proposed by Dr. J. Frank McCormick perhaps best represents the approach.[18] McCormick suggests the following steps for an ecological analysis:

1) Identify species present.
2) Determine species distribution and abundance.
3) Identify species associations, and describe the distribution and abundance of the major plant communities.
4) Interpret what factor or factors most strongly influence species distribution.
5) Relate species and community distribution to ecological processes which should be considered in development plans.
6) Attempt to place relative importance values on individual species, communities and areas of the study area.
7) Recommend certain development procedures which should or should not be followed.

The ecological analysis, thus traces the linkages and interdependencies among environmental elements at a more detailed level than is approached in a broad natural systems inventory. The key operating assumption is that an area which incorporates several subsystems (for example, a coastal marshland which is a multiple species --fish, wildlife, and vegetation--habitat) is necessarily more complex and thus less tolerant to human activity.

McCormick's approach would lead to the development of a site design plan which specifies precisely what species, populations, and community size and location should be preserved to maintain the "character" of the area as a viable eco-system.

## Visual Landscape Analysis

The third approach to environmental system evaluation for planning is the visual landscape analysis. The overriding objective of the visual analysis approach to the study of environmental systems for planning is the identification, protection and enhancement of landscapes which contribute to the visual quality of the environment. The operating tenet of the visual analysis, however, is that landscapes with visual quality are likely to be significant in terms of physical and biological processes which are focussed there; therefore, those areas should be carefully managed to protect a resource significant not only for reasons of amenity or aesthetics but also the general health and safety of man and nature.

## The Third Front: The Land Use Guidance System

New goals, new information and a new emphasis on implementation have spawned the development of many new methodologies for incorporation in the land use planning process. The potential synthesis of these methodologies points to a new land use planning process which we have termed guidance system planning. The ultimate aim of this new process is the infusion of goals and information, which now reflect an environmental system or natural process orientation, into the urbanization process. In this section, an operational view of the guidance system planning process will be presented in some detail.

## Stage 1: Inventorying, Monitoring, and Prediction

The first stage in the process involves an inventory of natural systems in the area, existing land use, and many other factors traditionally analyzed as informational input for land use planning. In addition, indicators of urban and environmental system performance may be monitored to explore current trends and predict future system performance. Essentially, the inventory is a background study intended to delineate the scope of local problems related to the goal of environmental quality. Hence, the inventory stage facilitates the definition of goals into objectives.

The information system for environmental systems produced through the inventory may be combined with a monitoring of urban growth or a predictive model of potential growth patterns to forecast possible points of conflict between development demands and natural system demands. The "Early Warning System" developed for the Santa Cruz Mountains area illustrates one approach to developing such a prediction capacity.[19] Essentially, the model is "a predictive tool for locating potential development and dynamics conflicts."[20]

> The "Early Warning System" model illustrates a method of predicting those areas where there is likely to be a conflict between natural dynamic systems and five forms of development: selected residential, logging, tree farming, grazing and speciality crops. All of these uses are presently found in the study area, but the method is theoretically applicable to any use. The system includes a comparison of a mapped expression of developer interests in terms of physical potential with a mapped expression of the natural dynamic systems of the same area. Land uses are reduced to a common level by the consideration of the actual physical impacts which development produces rather than its "land use" category. With the use of an Early Warning map the planner could easily identify the areas which are likely to have potential impact problems in advance of actual development. The nature of additional information which is required can be identified through an impact analysis process and land use policies can eventually be developed to avoid or at least minimize further environmental degradation. The model, carried out in this study by traditional mapping methods, is based upon a coordinate grid system which was developed to efficiently store quantities of complex information so that it could later be converted to a computerized information system.

| | STAGE 1 | STAGE 2 | STAGE 3 | STAGE 4 | STAGE 5 | STAGE 6 |
|---|---|---|---|---|---|---|
| THEORETICAL RATIONAL PLANNING PROCESS | Problem identification and analysis | Goals, objectives, and choice criteria | Formulation of alternatives | Evaluation of alternatives | Action decisions | Feedback |
| LAND USE PLANNING ACTIVITIES | Inventorying, monitoring, prediction interpretation | Formulating general goal oriented decision guides | Formulating specific decision guides and action instruments | Testing alternative plans and predictions | Selecting and implementing action instruments | Monitoring the urban environmental system and performance action instruments |
| OUTPUTS OF PLANNING ACTIVITIES | Background studies, status reports, suitability maps | Goal plans, choice criteria policies, strategies | Specific<br>Budgets, policies, plans, programs, projects, model regulations, incentives | Effectiveness and environmental impact analyses | Indirect actions:<br>Regulations, Incentives, Public investments.<br>Direct actions:<br>Public investments | Monitoring environmental quality indicators.<br>Public surveys.<br>Political activities. |
| CONSEQUENCES | | | | | | |

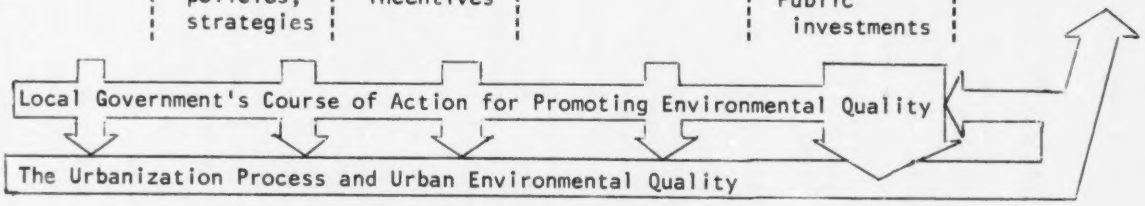
Local Government's Course of Action for Promoting Environmental Quality
The Urbanization Process and Urban Environmental Quality

FIGURE 1

LAND USE GUIDANCE SYSTEM PLANNING PROCESS

## Stage 2: Formulation of Decision Guides

Decision Guides are those plans, policies, budgets, and procedures developed by the planning staff to aid the local governing body in their decision-making capacity.

Traditionally, the land use plan has served as a decision guide. The land use plan is a very generalized vision in map form of the desired future physical characteristics of the urban area in terms of the location, intensity, and amount of land which will be developed for various space-using activities. Insofar as the land use plan presents a visual interpretation of physical characteristics, some twenty years hence, it has not been the most effective context of information and objective clarification necessary to evaluate the implications of these more discrete day to day decisions affecting land use. Thus, the land use plan is often supplemented by policy recommendations as well as more detailed policy and program plans focussing on more specific issues within a shorter time horizon than the ten to twenty year reference of the traditional land use plan.

The Optimum Land Use Plan for Redmond, Washington is an example of a land use policy guide which emphasizes development based on congruence with natural land features.[21] Land capability was evaluated in terms of surficial geology, current pollution levels (air, water, and noise), physiographic features (surface water, marshes, 100 year flood plain, acquifer recharge areas, slopes), climate and hydrology, vegetation and wildlife. Development principles appropriate to the conservation or improvement of each factor were recommended. Prior to the design of the "optimum" land use plan, the compatibility of land use to land use (e.g., camping with suburban residential development) and land use to land (e.g., commercial activity to slopes over 30%) was assessed as either being incompatible, moderately compatible, or fully compatible. In addition, each type of land use was rated as severe, moderate or minimal in terms of its potential adverse environmental consequences (e.g., soil erosion or stream sedimentation potential). The resulting matrix of "land use intercompatibility" was then a decision guide for the plan design stage. Furthermore, a policy to "optimize multiple compatible uses, as well as single uses" was posed as a decision guide. Other inputs to the design stage included evaluations of the economic base, projected land absorption, population growth, housing needs, development pressures (including parcel size and distribution and the prevalence of land speculation) and existing and projected land use distribution.

The Huntington, New York Environmental Planning Program discussed previously, is an example of a stricter policy plan approach.[22] No future land use plan in map form is presented. Rather, specific management actions are recommended, evolving from an inventory of the natural systems in the area. These actions would apply generally throughout the area (e.g., the prohibition of nitrogen-carrying fertilizers). In addition, certain areas of the town are singled out for special attention: remedial action (e.g., installing tertiary sewage treatment for existing development where cesspools and septic tanks exceed 1/acre); redevelopment of the urban infrastructure to restore ecological equilibrium (e.g., redesigning the storm drainage system into the local harbor); and protection of natural resources (e.g., public acquisition of remaining open spaces.)

A policy plan may focus on a more limited facet of the land use environmental quality interface. For example, the Southeastern Wisconsin Regional Planning

Commission has developed a Soils Development Guide.[23] The Guide was prepared for distribution to local jurisdictions within the seven county region. The Atlanta Regional Commission recently completed a policy plan for an area-wide resource, the Chattahoochee River Corridor. The plan examines the use of a 48 mile stretch of the river north of Atlanta and the adjacent land 2000 feet from each bank. The report recommends a comprehensive land development plan for the adjacent areas, development guides (some of which are posed for county-wide adoption, *e.g.*, soil erosion, sediment control and flood plain development regulations; others for adoption only within the 4,000 foot corridor, *e.g.*, general development standards, a "River Buffer Zone," Flood Hazard Zone, PUD standards; and a voluntary protection zone), and a program for public acquisition of certain areas vital to public recreation or the ecological health of the corridor.[24]

## Stage 3: Generation of Specific Policy Proposals

The third stage in the process is the generation of specific policy or project proposals. For example, in the Optimum Land Use Plan for Redmond, Washington cited above, it was recommended that the city acquire open space through less than fee simple purchase. If Redmond is to acquire open space in this manner, it must first determine which of the several approaches to less than fee simple purchase is most appropriate to its objective of open space preservation. Each of the alternative purchase arrangements must be examined in some detail. In the same plan, it was also recommended that floodplains, steep slopes, and marsh areas be carefully managed. Alternative approaches to such management remain to be proposed.

## Stage 4: Testing of Alternatives

The fourth stage in the process is the testing of alternatives. Alternatives may be tested for two purposes: First, to determine the general effectiveness of the proposal in achieving the objectives desired and secondly, to determine the environmental impact of the proposed action.

Evaluation of Effectiveness. In the "Computerized Guidance System" developed by Bucks County, Pennsylvania, a variety of data is collected and organized on a 22.95 acre grid basis and placed in a computer file. Various development policies may then be translated into model form in order to "relate the effect of a set of policies on a plan...to assist the County commissioners in establishing and following policies to achieve the desired end."[25]

A series of policies was combined to produce a County Park Plan using this system of data and modeling links. Seven major policy areas were defined related to open space objectives: maximum utility, site quality, accessibility, proximity, land value, supply and demand, and threat. For example, in terms of maximum utility, the operating policy was that "the park site which is suitable for the greater number of recreation activities is a better site than one suitable for fewer activities." Each policy was then converted into a model:[26]

> Some of these models are sets of overlays, whereby a variety of factors are combined to determine suitability for parks. The Site Quality Map is illustrative of this type model. The accessibility model is a behavioral model, based on a formula derived from a survey of county residents. Its

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> basis is the observed effect of distance on frequency of park visitation. The threat model is a simulation model. Variables were: population growth by municipality, vacant land by municipality, presence of sewers, proximity to highways, and existing urbanization. No attempt was made to base this model on observed data.

The models for each objective were given a priority weighting and the combined model then applied through use of a computer to each cell, resulting in a score for each. The outcome was a priority listing of acquisition sites.

The approach is also being used to develop a Natural Resources Plan for Bucks County.[27] The entire plan will consist not only of a land use intensity plan based on a comparison of each planning cells natural features, its sensitivity to development, but also a set of implementation policies and the integration of the Natural Resources Plan with other elements of the Comprehensive Plan. The Natural Resources Plan, still in the first stages, involves three major steps:[28]

> The first step in developing the Natural Resources Plan is to establish operational definitions for the various natural critical features of Bucks county.... Evaluation and weighting of critical natural features is the next step in plan development. Priorities for protection are established. ....The last phase in plan development is the setting of priorities and targets. Major policy issues are tested. For example, one policy might be to protect the most threatened resources. A conflicting policy would be to protect areas where land values are low and the most land could be preserved for each dollar spent. Both are valid planning concepts. A weighting system can incorporate the two into a single plan which may be pre-tested by computer, whereas intuitive discussions of conflicting policy issues often lead nowhere.

Evaluation of Environmental Impact. In addition to testing the potential effectiveness of a plan, policy, or regulation, there is now a trend toward testing the environmental impact of alternatives. Most evaluation methodologies developed thus far are applicable at the project level and are not suited for the evaluation of a general plan such as a land use plan. These methodologies focus on producing an information display matrix for the decision-maker.

The information display matrix approach is useful because although models of the various environmental sub-systems have been developed in which the various elements of the single sub-system have been weighted in terms of importance to the system function, there is yet no accepted model available in which the relative importance of all the sub-systems has been determined. To a certain extent, the relative importance will vary depending on the objectives of the given community involved.

## Stage 5: Selection of Action Instruments

The fifth stage of the guidance system planning process involves making a decision or choice among the alternatives which have been evaluated. It may be generally stated that no single tool is effective in and of itself. The essence of guidance system planning is the design of a series of action instruments which, operating in concert, create a new set of conditions and rules for urban development.

This discussion of land use guidance instruments focusses on the control of the pattern of urban development and is centered around three fundamental objectives:

1) The control of the spatial location of development;

2) The control of the timing or sequence or development; and

3) The control of the spatial design characteristics at the site.

## The Control of the Spatial Location and Timing of Development

Much of the early concern with techniques for controlling the location and timing of development was related to four "needs":[29]

1) to economize on the costs of providing municipal facilities and services and to maintain them at a high quality level;

2) to retain municipal control over the eventual character of development by preventing premature and sporadic building in unripe places;

3) to maintain a desirable degree of balance among various uses of land;

4) to achieve greater detail and specificity in development regulation.

Yet, over time, these "needs" have remained valid although their circumstantial basis has expanded to include: municipal fiscal balance, equitable housing opportunity for all socio-economic groups, provision of adequate public facilities to insure public health, safety, and welfare, and more recently prevention of development where and/or when it would impact adversely on the environment.

Assuming that an environmentally sound land use plan has been developed for the area, three general categories of implementation tools exist - zoning, taxation policies, and major public investments such as transportation, water, and sanitary sewer systems.

Innovation in zoning has been characterized primarily by the creation of new types of zones or districts. These include the following:

Large Lot Zoning--This zoning technique involves designating areas, which are deemed valuable for their natural resources, agricultural potential, or simply as open space, for very low density (minimum 1-5 acres) single family or agricultural use. This approach may be useful for areas difficult to service with public water and sewer in the near future and which would become environmentally degraded through high density development.

Exclusive Agricultural Zoning--The Village of Harristown, Illinois Zoning Ordinance states that[30]

> The Agricultural Zone is established as a zone in which agricultural and certain related uses are encouraged as the principle uses of land. The specific intent of the Agricultural Zone is to facilitate the long term use of lands best suited to agricultural production by preventing a mixture of urban and rural uses which place unbalanced tax loads on agricultural lands and which may result in speculative or inflated land values which encourage the premature termination of agricultural pursuits.

Three comments on effective agricultural zoning should be made. First, the tax assessment policy on such land is a crucial factor. Too often, development pressure in urban fringe areas brings a rise in the property tax on agricultural lands, agricultural becomes uneconomical. Secondly, exclusive agricultural zoning is intended to promote agricultural activity. Therefore, it should be applied only to prime agricultural land if zoning is to be used, in fact, in keeping with the best and highest use doctrine. Thirdly, "...many farmers will resist such a zoning classification, unless reassured that their property will be re-zoned when they want to sell at speculative values".[31]

Conservation Zones--Borrowing again from the Harristown, Illinois Zoning Ordinance,[32]

> The Conservation Zone is established to prevent the construction upon or alteration of rural or natural environments which have natural conditions of soil, slope, susceptability to flooding or erosion, geological condition, vegetation or an interreaction between the aforesaid which makes such lands unsuitable for urban development. Further, this zone is established to protect areas of the environment, that, if altered, would cause health, or pollution problems and environmental degradation. The Conservation Zone will also insure adequate areas for future conservation and recreation pursuits. Certain agricultural uses would be permitted.

Conservation districts, which are sometimes called Natural Resource Districts, are intended primarily for conservation use alone although agriculture is often permitted. For example, the Coon Rapids, Minnesota City Code establishing a Conservation District cites the following permitted uses:[33]

(i) Outdoor recreational uses operated by a governmental agency or conservation group, homeowners or private association and facilities for making some useful to public or association.

(ii) Open space areas connected with residential, commercial, and industrial planned unit development.

(iii) Conservation uses including drainage control, forestry, wildlife sanctuaries and facilities for making some available and useful to public.

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(iv) Agricultural uses.

(v) Nature study areas and arboretums.

A number of more specific, yet still conservation-oriented, zoning approaches and other development ordinances have been developed: flood plain zoning,[34] coastal plain zoning,[35] wetlands zoning,[36] stream bank zoning,[37] shoreland zoning, and steep-slope zoning (or hillside ordinances).[38] Oftentimes a special use permit is required for any construction in environmentally sensitive areas or for types of development with a high impact potential. Special use permits allow for a greater degree of detail and flexibility in controlling the quality of development and its impact on the environment.

Innovations in taxation policy to control the timing and location of development have been closely related to attempts to establish and retain conservation and agricultural zones. The Southeastern Wisconsin Regional Planning Commission notes that:[39]

> Under present Wisconsin Constitution and Statutory Law, the most satisfactory way to relieve the owner of lands zoned for exclusive agricultural or conservancy use from unrealistically high property assessment and taxation is to remove the development potential. This may be accomplished in one of three ways:
>
> 1. The property owner may voluntarily grant an easement to a local unit prohibiting development for a period of at least 20 years.
>
> 2. The property owner may voluntarily place restrictive covenants upon the lands enforceable by a governmental unit in perpetuity or for some substantial period of time.
>
> 3. A governmental unit may purchase the development rights.

Minnesota's "Green Acres Law" (Chapter 60, Extra Session Laws of 1967) authorizes the owner of agricultural land to receive a deferment on property taxes. Agricultural land is assessed according to its market value given that use until it is sold or converted to urban use.

The Livingston County, New York Planning Board is now utilizing the "Agricultural Districts" Law enacted by the State in 1971, designated "to encourage continuance of a strong agricultural industry in the state and to discourage urban scatteration into good farm areas."[40]

Pennsylvania's Act 515, passed in 1965, is based on the same concept of tax abatement or deferral. Act 515, however, differs from some other state's laws in that it is applicable to a wider range of natural resource areas than simply agricultural. Act 515 "enables certain counties of the Commonwealth to covenant with land owners for the preservation of land in farm, forest, water supply or open space uses."[41]

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Innovations in the area of public investment to control the location and timing of urban development have been characterized by an increased recognition and use of public utility and transportation systems to shape urban growth patterns.

The Metropolitan Council of the Twin Cities, Minnesota has adopted a "Diversified Centers" growth strategy.[42] That portion of the Metropolitan Development Guide dealing with sanitary sewers states the following policy with respect to their use as a device to implement the growth strategy:[43]

> -Phase interceptors extensions to promote orderly and economic development.
>
> -Extend interceptors into communities only when the residents are assured of governmental capability to provide a full range of urban services and to exercise adequate planning and control.
>
> -Prohibit extension of sewer systems into areas where development should not occur, such as flood plains, airport clear zones, major groundwater recharge areas, and areas designated for open space use.

Similarly, the Development Guide indicates that open space, transit, and thoroughfares will also be used as means to implement the development plan.[44]

Two basic approaches to achieving an interface between public investment planning and land use planning have been offered. The first, termed Framework or Development District Zoning, is more a technique for utilizing comprehensive capital improvement planning to control the location and timing of development than a zoning technique in the traditional sense emphasizing the segregation of incompatible uses. For example, Bucks County, Pennsylvania, as described previously, has proposed the use of a development district concept. Four types of development areas are proposed: Urban, Development, Rural Holding, and Resource Protection.[45]

Growth is encouraged in Development Districts not only through the provision of public services based on a five year program but also rezoning parcels in the area to more intensive uses. Only in Development Areas is more specific use zoning applied. Rural Holding Districts are placed in a "wait-and-see" condition and would be reevaluated periodically. Development in Holding Districts would be discouraged through several measures. Public services would not be extended for five years at least. Other effectuation measures would include large lot zoning (minimum 5 acres), lower tax assessments under Act 515 (previously discussed), prohibition of development on sites exhibiting unfavorable percolation, agricultural management and assistance programs for farmers in the area, and public education. Development would be discouraged or prohibited in Resource Protection Areas through resource protection zoning of critical areas, reservation by official map of protection areas to be acquired within three to five years, the purchase of development rights or easements, and other measures.

The second approach to coordinating public investments to control the location and timing of development is the use of a Development Timing Ordinance. Although this type of ordinance is not entirely new,[46] its recent revival by the town of Ramapo, New York has created a great deal of interest.[47] In 1969, Ramapo[48]

> ammended its zoning ordinance to create a new kind of "special permit" use labeled the "Residential Development Use." Anyone

> wanting to use land for residential development cannot do so without a special permit. And a special permit is granted only if standards are met for minimum facilities and services available to the new development. The required services include sewerage, drainage, parks or recreation, schools, roads, and firehouses. The ordinance sets up a point system of values assigned to these services. A special permit requires a proposed development to satisfy at least 15 development points. The town, for its part, is pursuing an overall development plan and a capital improvement program drawn from that plan. If services needed for residential development are missing, Ramapo proposes to include them within its 18-year program of capital improvements, of which the first six years are specified in a capital budget.

## The Control of the Spatial Design Characteristics at the Site

Basically, there are three ways to protect the environment by controlling the spatial design characteristics of development: the use of density zoning or planned unit development ordinances; the inclusion of critical environmental provisions in zoning, subdivision, building, or health ordinances; and the requirement of environmental impact analysis on proposed development as a prerequisite to the granting of a reasoning, subdivision plat, or building permit.

Essentially, both density zoning and planned unit development offer the developer flexibility in designing the site as long as the overall density restriction and other requirements as for improvements are met. This flexibility offers the potential for promoting environmental quality since development may be clustered and sensitive areas retained as open space. Most density zoning or planned unit development ordinances require the submission of a site plan as a prerequisite to approval. Through site review, assurance can be made that the most optimum site design environmentally has been achieved. Bucks County has proposed a rather innovative addition to standards for cluster developments. Not only would density requirements be stipulated but so, too, would an open space ratio and an impervious surface ratio (a ratio of all surface area impervious to rain--buildings, parking areas, driveways, roads, sidewalks, etc.--to the gross site area).[49]

A second means to control spatial design characteristics is through the inclusion of critical environmental provisions in zoning, subdivision, building or health (e.g., septic tank ordinances) ordinances. For example, the Buffalo County, Wisconsin Zoning Ordinance includes a wet soils, a steep soils, and a suitable soils districts as overlap of all general zoning districts and which carry supplemental controls over land use in addition to the regulations of the respective primary districts.[50]

The third approach to site control is to require developers to submit an environmental impact evaluation on proposed development. Although where such a requirement has been adopted it is limited to a disclosure requirement only, it does tend to shift the ultimate responsibility for environmentally sound development practice to the developer.

The Rocky Mountain Center on Environment has proposed a Model Environmental Subdivision Regulation which would extend the impact statement requirement concept beyond simply disclosure. No subdivision permit would be granted unless the "Environmental Inventory and Analysis" was adequate and insured that the following provisions would be met:[51]

A. Will not result in water pollution. In making this determination, they shall consider: the amount of rainfall received by the area, the relation of the land to flood plains, the nature of soils and subsoils and their ability to adequately support waste disposal; the slope of the land and its effect on effluents; the presence of streams as related to effluent disposal; the applicable health and water resources department regulations.

B. Does have sufficient water available per lot, both physically and legally, for the foreseeable needs of the subdivision or development.

C. Will not cause an unreasonable depreciation of an existing water supply.

D. Will not cause unreasonable soil erosion or reduction in the capacity of the land to hold water so that a dangerous or unhealthy condition may result.

E. Will not cause air pollution. In making this determination, they shall consider: the elevation of land above sea level; land topography; prevailing winds or the absence thereof; local and regional airshed; increase in sources, or quantity of emissions, as well as quality of such.

F. Will not cause unreasonable highway congestion or unsafe conditions with respect to use of the highways existing or proposed.

G. Will not cause unreasonable burden on the ability of a school district to provide educational services.

H. Will not place an unreasonable burden on the ability of the local governments to provide water, sewage, fire, police, hospital, solid waste disposal, and other services.

I. Will not have an undue adverse effect on the scenic or natural beauty of the area, aesthetics, historic sites or rare and irreplaceable natural areas.

J. Will not have an undue adverse effect on wildlife and their habitat, on the preservation of agricultural land, on human psychological-physiological dependence upon open space, and on the boundary-line defining urban land use from rural.

K. Is in conformance with a duly adopted master plan, land use plan or land capability plan.

## Stage 6: Feedback and Monitoring

The final stage in the guidance system planning process, feedback and monitoring, brings the process full circle. Evaluation of urban system performance is obviously necessary to maintaining an adequate information system for continuous planning.

The guidance system planning process depicted as the third front of innovation in land use-environmental quality planning remains a rather theoretical concept. Yet, to a certain extent, it is the organizing concept of much planning activity at the local level.

## Notes

[1] See, for example: F. Stuart Chapin, Jr., Urban Land Use Planning (Urbana: The University of Illinois Press, 1966); Ira S. Lowry, Model of Metropolis.

[2] J. Thomas Atkins, et al., Huntington Environmental Planning Program (Philadelphia: Department of Regional Planning and Landscape Architecture, University of Pennsylvania, 1972).

[3] Interview with Michael Pawlukiewicz, Environmental Planner, Department of Environmental Protection, Huntington, New York, November 24, 1972.

[4] Los Angeles Department of City Planning, An Environmental Conservation Element for the Los Angeles General Plan, Draft report (Los Angeles: Department of City Planning, 1970).

[5] California State Code, Title VII, Chapter 3, Local Planning.

[6] Los Angeles Department of City Planning, op. cit.

[7] Section 21151 of the Public Resources Code of California, as amended by Chapter 1433, Stats. 1970.

[8] Telephone Interview with Francis P. Bennett, Director Wayne County, Michigan Planning Commission, December 21, 1972.

[9] Wayne County Planning Commission, Planning and the Environment, Vol. 2 of Comprehensive Planning Process for Wayne County (3 vols.; Detroit: Wayne County Planning Commission, 1970-72).

[10] Albuquerque-Bernallillo County Planning Department, The Comprehensive Plan, Metropolitan Environment Framework (Albuquerque: Albuquerque-Bernallillo County Planning Department, 1972).

[11] Metropolitan Washington Council of Governments, Natural Features of the Washington Metropolitan Area (Washington, D. C.: Metropolitan Washington Council of Governments, January, 1968).

[12] Ibid.

[13] Ian McHarg, Design With Nature (Barden City: Natural History Press, 1969).

[14] Wallace, McHarg, Roberts and Todd, An Ecological Study of the Twin Cities Metropolitan Area (St. Paul: Twin Cities Metropolitan Council, 1969).

[15] Ibid.

[16] Ibid.

[17] Ibid.

[18] Interview with J. Frank McCormick, Professor of Botany at the University of North Carolina, Chapel Hill, October 10, 1972.

[19] Tito Patri, David C. Streatfield, and Thomas J. Ingruire, *The Santa Cruz Mountains Regional Pilot Study, Early Warning System* (Berkeley: Department of Landscape Architecture, College of Environmental Design, University of California, August, 1970).

[20] Ibid.

[21] Redmond Department of City Planning, *Optimum Land Use* (Redmond: Department of City Planning, 1972).

[22] Thomas J. Atkins, et al., *op. cit*.

[23] Southeastern Wisconsin Regional Planning Commission, *Soils Development Guide* (Waukesha: Southeastern Wisconsin Regional Planning Commission, 1969).

[24] Atlanta Regional Commission, *Chattahoochee Corridor Study*, Draft report (Atlanta: Atlanta Regional Commission, July, 1972).

[25] Lane H. Kendig, "Computerized Guidance System as Developed in Bucks County," presented at Confer-In-West, Annual Meeting of the American Institute of Planners, San Francisco, Calif., October 24-28, 1971, (mimeographed, available from The American Institute of Planners, 1776 Pennsylvania Ave., Washington, D. C.)

[26] Ibid.

[27] Bucks County, Pennsylvania Planning Commission, Natural *Resources Plan for Bucks County* (Doylestown: Bucks County Planning Commission, 1971).

[28] Ibid.

[29] Henry Fagin, "Clinic: Development Timint," *Planning 1955* (Chicago: American Society of Planning Officials, 1955).

[30] Village of Harristown, Illinois, *Zoning Ordinance* (Harristown: Village of Harristown, 1972), section 3.1.

[31] Gunnar C. Isberg, "Development Problems in the Urban-Rural Fringe: Need for Unified Plans and Programs," Submitted for presentation at Confer-In 72, Annual Meeting of the American Institute of Planners, Boston, Octover, 1972.

[32] Village of Harristown, Illinois, op. cit., section 3.1.

[33] City of Coon Rapids, Minnesota Ordinance No. 378, "An Ordinance Creating a Conservancy District Designated (CD) and, Therefore Amending City Code Chapter 11-300," May 9, 1972.

[34] See: Chapter VII; and Jon A. Kusler and Thomas M. Lee, *Regulations for Flood Plains*, Planning Advisory Service Report No. 277 (Chicago: American Society of Planning Officials, February, 1972).

[35] See: James C. Hite and James M. Stepp, eds., *Coastal Zone Resource Management* (New York: Praeger Publishers, 1971).

[36] See: Jennifer G. Turner, "Preservation of Wetlands: A Critical Evaluation of Connecticut's Approach," Submitted for presentation at Confer-In 72, Annual Meeting of the American Institute of Planners, Boston, October, 1972).

[37] See, for example: Atlanta Regional Commission, *Chattahoochee River Corridor Study* (Atlanta: The Commission, July, 1972).

[38] See: American Society of Planning Officials, *Hillside Development*, Planning Advisory Service Report No. 126 (Chicago: American Society of Planning Officials, September, 1959).

[39] Southeastern Wisconsin Regional Planning Commission, op. cit.

[40] Livingston County Planning Board, *Agricultural Land Resources and Conservation Areas* (Geneva, New York: Livingston County Planning Board, 1972).

[41] Bucks County Planning Commission, "Plan for Implementation of Provisions of Act 515 of 1965," (unpublished, Doylestown: Bucks County Planning Commission, February 3, 1971).

[42] Metropolitan Council of the Twin Cities Area, *Metropolitan Development Guide. Major Diversified Centers - Policies, System Plan, Program* (St. Paul: Metropolitan Council, February, 1971).

[43] Metropolitan Council of the Twin Cities Area, *Metropolitan Development Guide. Sanitary Sewers - Policies, System Plan, Program* (St. Paul: Metropolitan Council, 1970).

[44] Metropolitan Council of the Twin Cities Area, *Metropolitan Development Guide*. *Diversified Centers - Policies, System Plan, Program*.

[45] Bucks County Planning Commission, *The Urban Fringe: Techniques for Guiding the Development of Bucks County*.

[46] See, for example: Phillip P. Green, Jr., *et al*., "Clinic: Development Timing," *Planning 1955* (Chicago: American Society of Planning Officials, 1955); David Heeter, *Toward A More Effective Land Use Guidance System: A Summary and Analysis of Five Major Reports* (Chicago: American Society of Planning Officials, 1969).

[47] See: "Ramapo," *Planning, The ASPO Magazine* Volume 38, No. 6, (July, 1972).

[48] Ibid.

[49] Bucks County Planning Commission, "Proposed Amendment to Middletown Township Zoning Ordinance," unpublished (Doylestown: Bucks County Planning Commission, 1972).

[50] Buffalo County, Wisconsin, *Zoning Ordinance* (Alma, Wisconsin: Buffalo County, 1965).

[51] Rocky Mountain Center on Environment, *Land Use Packet No. 1* (Denver: Rocky Mountain Center on Environment, November 1, 1971).

# ENVIRONMENTAL IMPACT STATEMENTS: MORE MYTH THAN REALITY[1]

Lyle J. Sumek*

Today, the provision for environmental impact statements is considered by many government officials as one of the most recently controversial environmental measures. The concept of assessing potential environmental consequences originated with the National Environmental Policy Act (NEPA) of 1969 which marked a dramatic shift in governmental policy and actions regarding the environment. In this act, Section 102 stated that federal agencies are required to prepare and use environmental impact statements (a detailed analysis of environmental factors within proposed action) in their agency's review process before they take any "major actions" including recommendations and reports on legislation which "significantly affect the quality of the human environment."[2] Since its enactment, many state and local governments have followed the federal example by adapting their own variation of environmental impact statements process. The purpose of this article is to assess the viability of using environmental impact statements, at the federal, state and local levels, as a means of improving environmental quality.

## I. Environmental Impact Statements: The Federal Approach

The provisions of NEPA have been compared in importance to the Full Employment Act of 1946, since it is designed to (1) bring about a national consensus and new direction for future development considering environmental quality and (2) modify and develop new decisionmaking processes considering environmental factors which were once neglected. In order to truly appreciate the significance of NEPA and the problems encountered in developing an assessment process, the legal requirements need to be briefly reviewed.

NEPA consists of three components: (1) a General Policy Statement was adopted which recognized that each person should enjoy a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of that environment. NEPA orders all Federal departments and agencies to use all practicable means to improve and coordinate their planning, functioning and programming in order for the Nation to achieve the following goals: (1) to fulfill the responsibility of each generation as trustee of the environment for succeeding generations; (2) to assure for all Americans safe, healthy, productive, and aesthetically and culturally pleasing surroundings; (3) to attain the widest range of beneficial uses of the environment without degrading or degradation, risk to health or safety or other undesirable or unattended consequences; (4) to preserve important historic, cultural, natural aspects of our national heritage and maintain wherever possible an environment which supports diversity and variety of individual choice; (5) to achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and (6) to enhance the quality of renewable resources and approach the maximum attainable recycling of depletiable resources.[3]

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(2) The Council on Environmental Quality (CEQ) was created for developing and implementing environmental policy. Although opposed by President Nixon, the creation of this new body was approved with Little Congressional debate or opposition. The CEQ is located in the Executive Office of the President and is composed of three members who shall be appointed by the President to serve at his pleasure, with and by the consent of the Senate.

Their primary functions include (1) the advising and assisting of the President on the preparation of the annual report called the Environmental Quality Report, which is available annually from CEQ; (2) the gathering of information concerning the conditions and trends in the quality of the environment, and analyzing and interpreting this information with the purpose in mind of submitting to Presidential study relating to these conditions; (3) the reviewing and assessing of the various programs and activities of the Federal agencies to try to assure their consistency with the environmental policy declared in the NEPA; and, (4) the reporting to the President at least once a year on the general condition of the environment.[4]

Although not created as a provision of NEPA, it is important to keep in mind the other agency of the Federal government which is responsible for environmental quality. The Environmental Protection Agency (EPA) was created December 2, 1970 in a reorganization of the executive branch, which entailed the consolidation of Federal programs dealing with air pollution, water pollution, solid waste disposal, pesticide regulation, and environmental radiation. The agency is headed by William D. Ruckelshaus. Although EPA and CEQ are both concerned with environmental policy there is significant difference between the two. CEQ is in the Executive Office of the President and is responsible for policy advice, reviewing and coordinating environmental impact statements as well as environmental control activities of all agencies. The staff is small which limits their involvement in other agencies' activities. On the other hand, EPA as an operating line agency is responsible for administering and conducting all federal pollution control programs, focusing on pollution control as a strategy for securing environmental quality as well as preservation of wildlife and natural resources. In the environmental impact statement process, EPA functions like any other federal agency in reviewing statements.

(3) The Environmental Impact Statement Process as outlined in NEPA was specifically designed as a way of assessing environmental consequences on proposals rather than a cursory exposition of agency intent or justification for the program. The intent is to have Federal agencies analyze their policy alternatives before actual decisions are made. The reason for including the action forcing procedure was the fear that in absence of such a procedure agencies might evade implementation of the policy. The remainder of this section will analyze how the impact process is being implemented.

Guidelines for Environmental Impact Statements: According to NEPA, the Council on Environmental Quality becomes the primary administrating body with the responsibility for developing explicit guidelines regarding the processes of preparation and reviewing of impact statements. On March 5, 1970, President Nixon issued Executive Order 11514, which outlined the implementation process for NEPA and clarified CEQ's role. In this Executive Order, the President stated that all Federal agencies' heads shall monitor, evaluate, and control on a continuing basis their agency's activities so as to protect and enhance the quality of the environment, to develop procedures to the farthest extent possible provisions of timely public information and understanding of Federal plans and programs with environmental impact in order to obtain the views of interested parties.[5] It also stressed that public hearings be used wherever appropriate and that the public be provided all relevant information including information on alternative courses of action. State and local agencies were encouraged to adopt similar procedures for informing the public concerning their activities effecting environmental quality. Finally, the Executive Order established the responsibilities of the Council on Environmental Quality, which includes (1) the evaluation of existing programs and policies of Federal agencies, to direct them toward the controlling of pollution and the enhancement of the environment and (2) the development of guidelines to the Federal agencies for the preparation of detailed environmental impact statements.

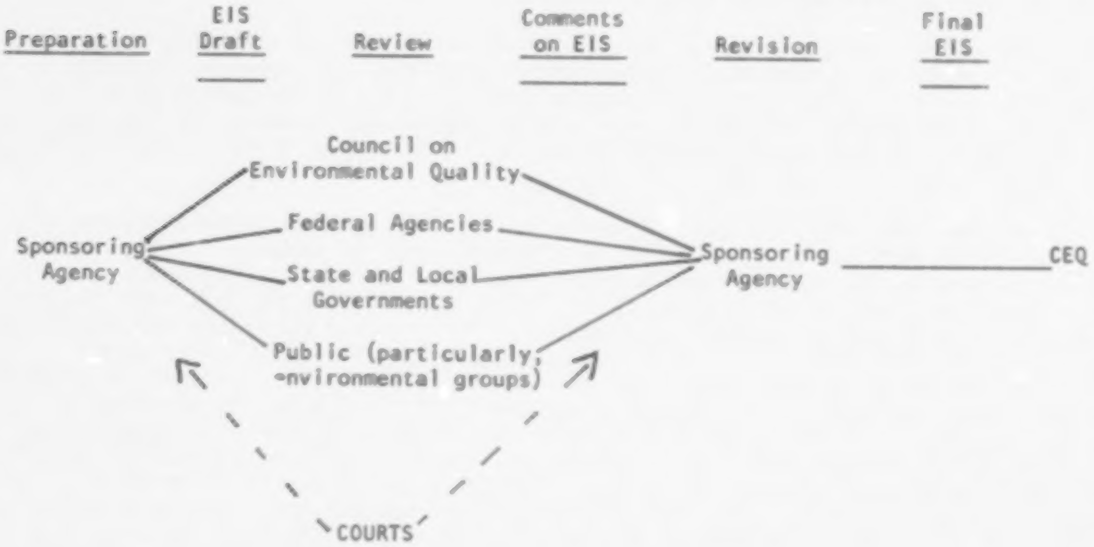
To standardize the process, CEQ issued general guidelines to Federal agencies on how to handle environmental impact statements that they must prepare. A major innovation was that draft statements must be made available to the public 90 days before an administrative action is taken, but not including proposals for, or reports on legislation. Final statements must be available for 30 days prior to such action for public comments on possible revisions.

On April 23, 1971, CEQ revised its guidelines integrating the requirements of Section 102 of NEPA and Section 309 of the Clean Air Act, as amended, which calls for public comment by the Administrator of EPA on proposed legislation, regulations or agency actions affecting EPA's areas of jurisdiction, including air and water quality, solid waste, pesticides, radiation, and noise. These revised guidelines applied to agency actions for draft statements circulated after June 30, 1971. All Federal agencies were asked to update their own procedures for writing and reviewing environmental impact statements which should be made available to CEQ for review prior to formal issuance. The new guidelines stressed the following points: (1) identifying types of agency actions requiring environmental impact statements, appropriate time for interagency consultations, and internal agency review process; (2) assuring advance comments from EPA; (3) including an adequate description of proposed action which will allow careful assessment by commenting agencies; (4) assuring to maximum extent practicable, the minimum 90 day periods of public availability for draft and final environmental impact statements; and, (5) allowing timely public information and understanding, which should include, where appropriate, public hearings and public access to draft and final environmental impact statements. However, in July, 1971, the U.S. Court of Appeals for the District in Calvert Cliffs' Coordinating Committee vs. AEC found that AEC had failed to provide for environmental review of cases in which a construction permit had been granted prior to NEPA's effective date, but an operating permit had not been granted at that time.[6] This ruling resulted in CEQ delaying the deadline for Federal agencies in submitting their guidelines so they could modify them in considering the court decision. As a result, it was not until November, 1971, that agencies' guidelines were submitted for CEQ and public review.

The ultimate goal of the CEQ guidelines is to make the process of formulating Federal environmental impact statements self-implementing, which means that environmental factors will receive proper consideration without court or CEQ intervention. However, achievement of the goal has been hindered by (1) the absence of a strong and comprehensive program to implement the legislation; (2) the fact that NEPA does not set forth any enforcement provisions to ensure compliance nor does it state that noncompliance is unlawful, and (3) a reluctance of agencies to modify their decision-making processes to incorporate the environmental impact statement process. The statement process so far has been one of reluctant implementation and cooperation. The courts have ended up playing the role of policing by determining whether agencies have fully and in good faith complied with the procedures. The result has been that the effectiveness of the environmental impact statement has depended upon the courts for elaboration and clarification through over two hundred court cases.

Today, the environmental impact statement process, as outlined in the guidelines and clarified in the courts, is complex, allowing departmental variation. A simplistic model of the overall process for developing an environmental impact statement is shown in Figure 1.

FORMULATION OF FEDERAL ENVIRONMENTAL IMPACT STATEMENTS


Preparation
EIS Draft
Review
Comments on EIS
Revision
Final EIS
Council on Environmental Quality
Federal Agencies
Sponsoring Agency
State and Local Governments
Public (particularly, environmental groups)
Sponsoring Agency
CEQ
COURTS

After a determination is made that an environmental impact statement should be written, the general process always consists of the preparation of a draft environmental impact statement which is then sent to CEQ, other Federal agencies, state and local governments, and public interest groups for review, with comments being sent back to the sponsoring agency where the draft environmental impact statement is revised and a final statement is issued. The courts, through their rulings on specific cases, have played an active role enforcing the procedural requirements of NEPA.

Requirement of Environmental Impact Statements: To fully comprehend this process, one must begin with the decision to write an environmental impact statement. Under Section 102, all Federal agencies have a duty to implement the national policy and to consider in the development of policies, regulations to the fullest extent possible on environmental matters. As part of this obligation, NEPA requires that an impact statement must be written for major proposals of legislation and other federal actions which may significantly effect the quality of the human environment. With the legislation using the terms "major" and "significant", many agencies have been able to exercise judgment in deciding the applicability of these terms in light of its knowledge of the nature and effect of its programs. This situation has resulted in much confusion over whether an environmental impact statement is required. During the first year and one-half, environmental groups brought many law suits against agencies forcing them to write environmental impact statements.[7]

Although there is some variation in many Federal agencies, a good example would be the Federal Highway Administration. It set forth the general criteria that statements must be drafted on all highways which are considered to be major actions and are likely to significantly affect the human environment, where organized opposition has occurred or is anticipated, and significantly affect historic or conservation lands. In defining what constitutes a major action, the guidelines stipulate that it includes any highway in an entirely or generally new location, or a major upgrading of an existing highway requiring functional changes such as adding medians, widening a road from two to four lanes, and extensive right-of-way acquisition. A significant environmental effect includes whether the project is likely to have an adverse impact on natural, ecological, cultural or scenic resources, to be highly controversial regarding relocation housing resources, to divide or disrupt an established community or disrupt orderly planned development or is inconsistent with plans adopted by the community, and to have a significant detrimental effect on air, water and noise pollution. Other agencies are more specific, as demonstrated in the Federal Power Commission cutoff line for hydro-electric projects at 2,000 horsepower.

In addition, many agencies have been confused over the requirement of environmental impact statements for activities begun or authorized before NEPA's enactment. Since NEPA contains no transitional language, the Council's guidelines tried to deal with this problem. If prior commitments, legal or financial, make it impractical to change the course of action, there should still be an environmental impact statement discussing the project's environmental effect and possibilities of minimizing adverse consequences from the remaining major actions. The retroactivity problem remains in the licensing of nuclear electric power plants. In the case of the Quad City Nuclear Power Station where construction was being completed on a project initiated before NEPA's enactment, the Atomic Energy Commission attempted to circumvent the environmental impact statement process by granting a partial operating license before a final environmental impact statement review of the application for full license was completed. The U.S. District Court for the District of Columbia in granting a preliminary injunction found that the issuance of a partial license constituted final agency actions requiring compliance with Section 102.[8]

Environmental impact statements are also required for certain environmental action by EPA authorized under environmental legislation. In the Kalur v. Resor decision, the U.S. District Court for the District of Columbia upset Federal anti-pollution programs relying on the activation of the long dormant 1899 Refuse Act. The suit challenged the government's right to issue permits for dumping of chemical pollutants into a nearby Grand River where Kalur goes canoeing. The decision prohibited the Federal government from issuing permits that shield polluters and potential polluters where Congress has specifically prohibited such activities. It found no merit in the Federal government's claim that environmental impact statements should not be required for issuance of pollution control permits.[9] EPA's position with regard to the requirements of Section 102, NEPA, were further clarified in the Federal Water Pollution Control Act of 1972. Section 511(c) exempts EPA from this obligation except for sewerage treatment plant construction and for discharge permits for new sources.[10]

A secondary question is when in the agencies' planning process should an environmental impact statement be written. According to CEQ's guidelines, environmental impact statements must be prepared early enough in the agency's review process to permit meaningful consideration of the environmental impact before agency action is taken. The courts, in several decisions, have stated that the environmental impact statements should come early in the agency's process in order to comply with NEPA, so that program formulation will be directed by research results rather than research programs being designed to substantiate programs.[11] This means that the agency must anticipate a minimum 90 day wait from the filing of the environmental

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impact statement to the initiation of action, which may be extended if the final environmental impact statement follows the draft by more than 60 days. If any revisions are required, the process may be extended even longer. It is important to note that these waiting periods do not apply to legislative proposals and reports and may be modified with CEQ consert under the following conditions: emergency circumstances, expense to the Federal Government, or impaired program effectiveness.

Preparation of Draft Environmental Impact Statements: After it determines that an environmental impact statement is required, the sponsoring agency prepares a draft statement using its own expertise and information. In the writing of statements, Section 102 requires that federal agencies must: (1) utilize a systematic interdisciplinary approach which will ensure the integrated use of natural and social sciences and the environmental design arts in planning and decisionmaking which may have an impact on man's environment; (2) identify and develop methods in consultation with the CEQ established by Title II of this Act to ensure that presently unquantifiable environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations; and (3) consult and obtain comments from other Federal agencies which may have jurisdiction under law or expertise with respect to the environmental impact, as well as Federal, state, and local agencies.

If two or more agencies are involved on the same project, one agency will be designated as the "lead" agency and assume responsibility for preparation and review of environmental impact statements. The designation of a "lead" agency is not as easy a job as it may look. For example, in the case of the Trans-Alaska Pipeline, the Department of Interior was the lead agency since it was the first federal agency involved when it granted the pipeline right-of-way permit across federal lands. However, if the pipeline had involved private or non-federal lands, it is not clear whether the Department of Interior or the Department of Transportation would have been the "lead" agency, since the latter department could have been involved on access roads and highways. The possible confusion lingers on.

Unless the state or local law requires its own environmental impact statement, a state prepares an environmental impact statement only when its actions are supported by Federal contracts, grants, or permits, and the procedures of the Federal agency have delegated initial preparation of statements to the state level. For example, the Federal Highway Administration, in providing matching grants for many state highway construction programs, has the appropriate State Highway Department prepare the draft statements, but takes responsibility for the final statement. Here, and in other cases where the state or local government is applying for Federal funds, the applicant is asked to consider and evaluate the environmental impact of the project. This part of the application becomes the agency's environmental impact statement.

In general, every Federal environmental impact statement should contain the following elements:

(1) a description of proposed action -- The description includes basic data concerning the project as well as existing and proposed land use and other existing environmental features.

(2) an analysis of the environmental impact of the proposed action -- This evaluation emphasizes significant beneficial and detrimental environmental consequences upon the state, region, or community. The environmental impact considers such factors as anticipated increases in urbanization and displacement of people.

(3) a discussion of adverse environmental effects which cannot be avoided should the proposal be implemented -- This evaluation focuses on such problems as water or air pollution, effects upon land, damage to life systems, urban congestion, threats to health, or other consequences adverse to the environment. Adverse effects include those which cannot be reduced in severity and those which can be reduced, but not eliminated, to an acceptable level. For the last two elements, courts have ruled that environmental impact statements must consider and balance opposing considerations. In the case of the Cannikin Underground Nuclear Test Committee For Nuclear Responsibility v. Seaborg, the U.S. Court of Appeals for the District of Columbia held that an environmental impact statement must inform the officials making the ultimate decision of the full range of responsible opinion on the effects of the proposal.[12] Therefore, a statement must set forth opposing views on significant environmental issues raised by the proposal. The Court stressed that it would be arbitrary and impermissible to omit from a statement any reference whatsoever to the existence of reasonable or responsible scientific opinion on such issues. What is required is a meaningful reference that identifies the problem at hand for the responsible officials. The significance of this decision is that the initiating agency is required to circulate a draft for comment, to discuss opposing opinion in an effective way to meld the best knowledge on the environmental issue, and to consider all major schools of thought in the draft statement. If there are responsible opinions of which the agency is unaware, they can be brought out in comments on the draft.

(4) an analysis and consideration of alternatives to proposed action -- The exploration of alternatives including an objective evaluation and analysis of the probable beneficial and/or adverse effects of each, including an alternative for no project at all or project termination. In National Resources Defense Council v. Morton, the U.S. Court of Appeals for the District of Columbia clarified recently the requirement of discussion of alternatives within environmental impact statements.[13] The agencies may not limit consideration of alternatives to alternatives which could be adopted by the agency issuing the impact statement, but rather must include the broad problem area and alternatives that could be implemented or developed by other agencies. The case involved the proposed sale of offshore gas and oil leases by the Department of Interior, estimated in worth at $400,000,000. The Court enjoined the sale on the basis that the environmental impact statement did not adequately discuss alternatives to the proposed action. Particularly, agencies may not limit alternatives which could be adopted and put into effect by the official or agency issuing the statement. All reasonable alternatives must be discussed, including those which depend for implementation on legislative or executive action outside direct control of the agency. The environmental impact statement is not only for the exposition of thinking of the agency, but also for guidance of those ultimate decisionmakers and must provide them with environmental effects of both proposals and the alternatives for consideration along with various other elements of public interest. In this particular case, the opinion set forth the specific alternative possibilities for meeting the energy crisis which should be discussed in the impact statements.

(5) the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity -- Short-term uses include construction, changes in traffic patterns, the taking of natural or man-made features, as compared to the long-term effects including foreseen changes in land use patterns, water and air quality, wildlife and other environmental factors.

(6) any irreversible or irretrievable commitments of resources involved -- Most projects require use of natural resources, such as forest or agricultural land, which are generally insignificant quantities. A project may generate other related actions that could reach major proportion and which would be difficult to rescind. For example, a new highway project which would provide access to a previously nonaccessible area acts as a catalyst for industrial, commercial, or residential development in the area.

In summary, a Federal environmental impact statement must be sufficiently detailed to allow an administrator to arrive at a reasonably accurate decision regarding environmental costs and benefits from program implementation. An adequate discussion of alternative proposals must allow for program modification during agency review in order to assure that their action will be in accordance with the goal in NEPA.

Review and Comment on Environmental Impact Statements: After a draft environmental impact statement is prepared, the sponsoring agency sends it out for review and comments by other Federal agencies which have a specialized expertise relating to the project and to state and local governments. Because of its small staff, CEQ may or may not comment. Their primary role has been to serve as a traffic coordinator for the flow of environmental impact statements, leaving most substantive comments to particular expert agencies. In an appendix to the CEQ Guidelines, there is a list of Federal agencies designating areas of expertise in a particular aspect of the environment which should be asked to comment. For example, in the area of urban planning the following agencies would be expected to have expertise and comment on the draft: Department of Transportation (Federal Highway Administration), Department of Housing and Urban Development, Environmental Protection Agency, Department of Interior (Geological Survey and Bureau of Outdoor Recreation), and the Department of Commerce (Economic Development Administration).

In addition, state, regional and local governments may be affected by the environmental impact statement. When necessary, copies of the draft environmental impact statement are either sent directly to that agency authorized to develop and enforce environmental standards or to the state, regional, or metropolitan clearinghouse set up by A-95, Office of Management and Budget. The scope of what actions are susceptible to state and local review is limited. Budget and legislation proposals are usually excluded from such local review.

Furthermore, the draft environmental impact statements must be made available to the public. Any individual, group, or organization may comment on the draft by expressing support or opposition, suggesting alternatives, or pointing out environmental effects which may have been overlooked. The comments may take a variety of forms -- a letter, a critique or a "counter-102 Statement" setting forth views and analysis of the draft. Many Federal agencies encourage the involvement of environmentalists by securing comments directly from local or regional environmental groups such as the Sierra Club and the National Audubon Society. Some agencies, like the Federal Highway Administration, are required by law to hold public hearings. In addition, Executive Order 11514 encourages other agencies to hold them as a process to obtain public opinion. For non-regulatory hearings, the draft environmental impact statements must be made available at least 15 days in advance.

In general, Federal agencies must allow at least 30 days for comments, with 45 days for EPA comments on the project. Some agencies have found that this is insufficient time and as a result have written longer periods in their procedures for the review process. In addition, CEQ Guidelines suggest that requests for 15 day extensions should be considered favorably.

Preparation of Final Environmental Impact Statements: After the comments are returned to the sponsoring agency, the information is used to modify the project, if necessary, and to prepare a final environmental impact statement. In the final statement, the agency must include copies of all comments received. It is the agency's responsibility to make comments available on request, with requests being directed at the agency's environmental liaison officer.

As of June 1, 1972, CEQ had received a total of 2,933 environmental impact statements, of which 1,552 were final statements. A breakdown by department of those which have frequent contact with local government follows: Department of Transportation, 1,696; Corps of Engineers, 438; Department of Agriculture, 188; and Housing and Urban Development, 34. By type of projects, the number submitted are as follows: roads, 1,436; watershed protection and flood control, 403; airports, 220; navigation, 186; electric power, 150; parks and wildlife refuges, 66.[14]

At the request of Representative John Dengill (D-Mich), Chairman, Subcommittee on Fisheries and Wildlife Conservation, House Committee on Merchant Marine and Fisheries, the General Accounting Office (GAO) conducted a study to evaluate the implementation of Section 102, NEPA, and the adequacy of selected environmental impact statements. The GAO selected one impact statement from the following agencies: the Soil Conservation Service, the Army Corps of Engineers, the Reclamation Bureau, the Federal Highway Administration, the Forest Service and the Department of Housing and Urban Development. Although the GAO report indicated that these agencies were concerned about the environmental consequences of their programs and projects, it concluded in general that the usefulness of impact statements was impaired by:

> (1) Inadequate discussion of, and support for, the identified environmental impacts which involved surface treatment of impact or, to an absense of indepth technical discussions of the consequences of proposed projects. Some conclusions were not substantiated with hard data and others were falsely or mistakenly reported. The impact of the projects was partially identified but the extent of the impact was not dealt with. There was also the tendency to completely ignore possible environmental consequences.
>
> (2) Inadequate treatment of reviewing agencies' comments on environmental impacts which involved the failure of agencies to circulate their plans to other agencies or to inadequately treat the expressed concerns and reservations of other agencies about the proposed projects. Often times public views were either not solicited or adequately considered.
>
> (3) Inadequate consideration of alternatives and their environmental impacts which involved not only the failure to conduct and/or report on indepth studies and to support conclusions reached with specific data, but also the failure to consider alternative proposals at all. The tendency was to merely state that X alternative was best and to leave it at that.[15]

In a similar study, an interdisciplinary team at the University of Colorado, under a grant from RANN of the National Science Foundation, reviewed and analyzed environmental impact statements through January 1972. They concluded that

> ...The impact statement process as it is now being implemented in government decisionmaking is not a very effective tool in protecting the

> environment. Although two-thirds of the actions for which statements were prepared had adverse environmental effects, the actions proceeded essentially unchanged. The EPA, which would appear to be an agency responsible for suggesting environmentally less damaging alternatives, did not comment in a majority of cases.[16]

Thus, although the decisionmaking process has been opened up to consider environmental factors and to allow public participation, the implementation of Section 102 has not followed the procedural requirements of NEPA.

In addition, neither NEPA nor the 102 process dictates the agency's choice of a particular alternative. Courts have ruled that after an agency has met the requirements of NEPA the agency's decision, whatever it may be, is subject to limited judicial review afforded by arbitrary-or-capricious and substantial-evidence tests. Thus, agencies may initiate a project although significant environmental damage may result.

## II. Environmental Impact Statements: State and Local Approaches

The requirement of environmental impact statements for federally funded projects at the state and local levels has stimulated many states as well as local bodies to write or draft and pass legislation similar to NEPA. As of Sepetmber 1972, ten states including Montana, Delaware, New Mexico, North Carolina, Washington, Wisconsin, Indiana, California, Arizona and Hawaii, had adopted some form of environmental impact statements at the state level. Arizona and Hawaii have adopted the requirements through administrative and executive orders, the other states through legislation similar to NEPA.

Although there are similarities in the provisions of the state requirements, there are some differences that are apparent. For example, in the state of Montana there is the Environmental Quality Council consisting of thirteen members, including representatives from the legislature, the public and the Governor's office. Their responsibilities include the development of guidelines for the preparation of impact statements as well as reviewing and commenting on Federal environmental impact statements. This Council is an arm of the legislature rather than the executive branch, and oversees the functioning of executive agencies. It also acts as an ombudsman for the public, with statutory power enabling it to investigate on its own initiative or the public request to ensure compliance with environmental protection laws. In Wisconsin, the Bureau of Environmental Impact is responsible for investigating and evaluating the total impact of public and private projects on the environment. Arizona's Game and Fish Department is now required to complete impact statements prior to the construction of any large scale water development. Hawaii covers projects built on state land or with state funds and must be filed with the Office of Environmental Quality. In Indiana and North Carolina the law requires environmental impact statements to be filed with the Governor.

California was the first state to adopt environmental impact procedures and has passed legislation similar to NEPA. Several unique features exist in the California law including: (1) the sponsoring agency is responsible for paying for the preparation of the environmental impact statement; (2) an environmental impact statement must include mitigation measures proposed to minimize impact; (3) cities are required to make environmental impact reports on any project which may have a significant effect, and submits them to the local planning agency; (4) all state reviews of federal projects must be conducted under the direction of their law, which results in Federal agencies receiving more information than is required presently under NEPA; and (5) the state act makes all environmental impact statements falling under its jurisdiction available to the state legislature and to the public. Guidelines were developed by the Office of Planning and Research.

In the beginning, environmental impact statements were prepared by public agencies on only public projects. However, in the Friends of Mammoth decision (Friends of Mammoth v. Mono County), the State Supreme Court ruled that environmental impact reports were necessary for any private construction projection that requires a permit and that could, or will have a significant effect on the environment. This meant state and local agencies must develop, if they do not already have, processes for developing and reviewing environmental impact reports.

A different approach to assessing environmental impact has been taken by Vermont. In 1970, the state adopted a land use law which gives the state the right to limit any development that could harm the environment. To enforce this right, the state requires developer on projects other than commercial and industrial developments on less than one acre or a lot strip development and zoning has resulted to file an impact statement in the process of obtaining a building permit. It is the responsibility of the developer to demonstrate that his development will not cause undue damage to the air, overburden the water supply, or cause unreasonable soil erosion.

The state has created eight district commissions which administer the program and are responsible for (1) studying the impact of the proposed project on the water supply, soil, natural beauty, population, and transportation system; (2) asking developers to modify his plans in order to minimize potential environmental damages; (3) holding, if necesary, public hearings in which the developers, environmental groups, civic groups, and governmental officials may discuss the issue, and (4) granting or denying the building permit. The Commission will be assisted by the state's Environmental Conservation Agency which may also study the developer's application and may make recommendations to the local commission. If an application including impact statement are approved by the district commission a permit is usually granted within 60 days. An appeal can be made to the Vermont Environmental Board, an independent and quasi-judicial arm of the state's Environmental Conservation Agency, and if necessary to the State Supreme Court. If the law is violated, the State can fine the developer $500 for each day of violation or imprisonment for not more than two years or both. So far, the effectiveness of the law has been hampered by (1) a lack of manpower to enforce the law, resulting in clearing and grading before applying for a permit, (2) insufficient guidelines for the developer in assessing potential environmental damage, and (3) weakening of the district commission when threatened with a lawsuit.

However, not all states feel that provisions similar to NEPA would be beneficial for them. They see the Federal process as ineffective and realize innovations are needed. During 1972, in the states of New York and Connecticut, the State legislatures passed some form of environmental impact statement similar to the provisions in NEPA. But they were vetoed by Governor Rockefeller and Governor Thomas J. Meskill. Although both governors were sympathetic to the underlying goal, their chief objection was to the confusion and to possible delays which might result from a requirement that all agencies file environmental impact statements before action is taken. In addition, the financial burden would increase since the implementation would require additional personnel and, in many cases, duplication of existing reviews.

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With the requirement of impact statements by the federal government and by many states, cities have implemented or plan to implement some format of environmental impact statements, programs, and projects in their own agencies. Cities see the environmental impact statements as a meaningful way of incorporating environmental variables and values into a decisionmaking process. They feel that environmental impact statements will increase the quality of decisions made in that city.

One of the first cities to adopt environmental legislation was Inglewood, California, which adopted a policy of environmental impact studies for projects over $25,000 or smaller projects which could be grouped collectively to $25,000. Adopted on May 23, 1972, their ordinance recognized that every project will have some environmental effect and thus some assessment is required on every project. However, this assessment may involve only an initial review determining that the environmental effects will be insignificant and that no further study is needed. The process is as follows: (1) the environmental standards divisions must establish guidelines for preparation of statements; (2) the operating agencies and departments prepare an environmental impact study according to guidelines (these statements are prepared after preliminary design but before adoption of design budget or construction budget); (3) the environmental impact studies are then reviewed by the environmental standards division which will confer with the operating department when revisions are necessary; (4) the impact study is reviewed by the planning division; (5) the city administrator reviews each statement and determines whether environmental safeguards are included in the project or if the environmental impact may be significant enough to warrant a public hearing. The environmental standards division estimated that environmental impact studies could be conducted. It was figured that less than one percent of the total project costs would be spent on conducting the environmental assessment. The environmental standards division also suggested on large projects, especially where the city had minimal expertise, that outside consultants be involved in writing and conducting the assessment.

Not all city officials or cities, however, look favorably upon the national program and its benefits, or see the necessity of creating their own procedure for writing environment impact studies. They have expressed concern over the efficiency of such a local program and the potential unnecessary delay it may cause in initiating needed projects in urban areas. They realize that at the present time it is hard enough to plan and develop a program and get city council approval without adding another step which would involve looking at how the environment is effected. Cities are, however, examining the question of whether they can develop some form of environmental impact statement process and are watching and analyzing the events both at the national and state levels.

## III. A Summary of Strengths and Weaknesses

At the present time, it is quite apparent that the process of meaningfully assessing environmental consequences for projects is more myth than reality. The present strengths and weakness of environmental impact statements can be summarized as follows:

Strengths:

(1) Many public agencies have modified their planning processes to include environmental considerations previously neglected.

(2) The decisionmaking process in government has been opened to increased public scrutiny through the involvement of environmental

and other interest groups in the impact statement process.

(3) As a result of having to write and review environmental impact statements many public agencies are developing their own technical staffs for dealing with environmental problems.

(4) Some projects which had the potential of being environmentally damaging have been stopped.

Weaknesses:

(1) The implementation of the environmental impact statement process has been inconsistent, with some agencies writing an excessive number of environmental impact statements, creating more paper work and less assessment.

(2) The cost of environmental assessment places additional financial burden on public agencies since they need some financial aid to cover the costs of hiring additional personnel or private consultants.

(3) The quality of environmental impact statements has been hampered by a lack of technical knowledge on such questions as what is environmental quality? What should be included in a good environmental impact statement? What is the present condition of the environment?

(4) The time in writing and reviewing impact statements has increased the length of time for application approval, thus delaying many projects while others review and comment upon the environmental impact statement.

(5) Public agencies and environmental groups have emphasized more the procedural requirements than the substantive content of the statements themselves.

(6) There has been some lack of political and administrative support at the federal level as demonstrated by (1) the enactment but non implementation of the Environmental Quality Improvement Act of 1970 which would have developed CEQ's staff for the environmental impact statement process and (2) the drive in Congress for exempting various agencies from having to comply with Section 102.

The trend toward more public agencies adopting some form of environmental impact statement is likely to continue. The potentiality of environmental impact statements for integrative public decisionmaking will be realized only if the weaknesses are overcome soon. If not, environmental impact statements will be even more a program justification than an environmental assessment.

## Notes

[1] A more comprehensive analysis can be found in the author's doctoral dissertation, *The Politics of Federal Environmental Impact Statements*.

[2] Public Law 91-190, 42 U.S.C. §4321 et. seq., 83, Stat. 852

[3] *Ibid*.

[4] *Ibid*.

[5] Executive Order No. 11514, 35 Federal Register 4247 (March 5, 1970).

[6] *Calvert Cliffs' Coordinating Committee* v. AEC, 449 F.2d 1109, 1113-4, 2 ERC 1779, 1781-82, 1ELR 20346; 20348 (D.C. Cir. 1971).

[7] *Scherr v. Volpe*, 336 F. Supp. 882, 888, 3ERC 1586, 1590, 2ELR 20068, 20070 (W.D. Wis. 1971) and *Natural Resources Defense Council v. Grant*, 3ERC 1883, 2ELR 20185 (E.D.N.C. 1972).

[8] *Izaak Walton League v. Schlesinger* (D.D.C. 1971).

[9] *Kalur v. Resor*, 335 F. Supp. 1, 3ERC 1458, 1ELR 20637 (D.D.C. 1971).

[10] Public Law 92-500.

[11] *EDF v. Corps of Engineers*, LR-70-C-203, (D. Ark. 1971) and *EDF v. Hardin*, CA 2319-70, (D.D.C., 1971).

[12] *Committee for Nuclear Responsibility v. Seaborg*, 3ERC 1126, 1ELR 20469 (D.C. Cir. 1971).

[13] *Natural Resources Defense Council v. Morton*, 3ERC 1623, 2ELR 20071 (D.D.C. 1972).

[14] U.S. Council on Environmental Quality. *Environmental Quality 1972.* (Washington, D. C.: Government Printing Office, 1972), pp. 248-249.

[15] U.S. General Accounting Office. *Adequacy of Selected Environmental Impact Statements Prepared Under NEPA of 1969*. Report to the Subcommittee on Fisheries and Wildlife Conservation, House Committee on Merchant Marine and Fisheries, 1972.

[16] Kreith, Frank, "Lack of Impact," *Environment* XV(January/February 1973), 30

# STRATEGIES FOR ENVIRONMENTAL MANAGEMENT

Allen V. Kneese*

Perhaps the most encouraging aspect of the present situation regarding natural resources and environment is the deep and widespread public concern about it. To a large extent, we owe this concern and even alarm to the ecologists. As an economist, I am interested to see that there is now a market developing for forecasts of disaster, and some competition is growing up among the practitioners of this art to see who can come up with the most ingeniously worked-out vision of the apocalypse.

An interesting example of inconsistent and even countervailing visions is with respect to the weather. We have been told that the discharge of $CO_2$ and heat to the atmosphere will cause the polar ice caps to melt and drown our cities. Now it turns out that in recent years the earth's temperature has been falling. Aha! -- we are told -- that is because the discharge of particulates into the atmosphere from human activities is reflecting the sun's rays. No, says another expert, not at all; volcanic action has been strong in recent years and by comparison the discharge of particulates from human activities is minimal.

I present this example not to try to generate confidence that our environmental problems are not so bad after all, but to point out that we know very little for sure about the impact of modern man's activities on the geophysical world, not to mention the biological world. In a way I would feel more comfortable if we knew for certain that we would raise the world's temperature by a degree or two over the next century, rather than to be so aware of the depths of uncertainty in which we operate. The same is clearly true, and could easily be documented, with respect to a host of more limited impacts than the global weather one just discussed.

Clearly, then, one highly important task before us is to strengthen and consolidate our geophysical and biological research efforts so that we can better understand these systems and the impacts on them of various events.

But of equal importance, and much neglected in the recent and often rather frantic discussions of the environment, is understanding why the social and economic systems produce the results they do and how we can use understanding of them to produce more desirable ones -- call it social engineering, if you will. Illustrations of the poverty of understanding in this area are the frequent calls for morality with respect to the environment (morality is clearly needed, but the problem is not primarily a matter of failing morals), wondering why the problem does not go away when federal subsidies are provided (federal subsidies may be needed to help catch up, but they do not do anything positive to change perverse incentive structures), and a search for technological fixes (technology can help as well as hurt, but it cannot, alas, relieve us of our task to design an economic and political system which produces desirable results).

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## Common Property and Private Property

It has often been said that what we need is a new morality or a new ethic if we are to avoid despoiling the earth. This is really a call for a new set of values which lays more emphasis on the natural, the tranquil, the beautiful, and the very long run. These are values very appealing to me, but holding them really says nothing about the social mechanisms through which they might be realized to a higher degree. Even "good" people need rules to live by, especially where the impact of a single person's behavior on the total problem is extremely small. Moreover, it has long been realized that a system which does not rely heavily on the fulfillment of the self-interest of the individual or the family must soon become undemocratic or unworkable.

A definition of environment or environmental quality which would suit everyone seems to be impossible. But I think that most social scientists have something like the economist's concept of "common property resources" in mind when they speak of the environment. The concept of a common property resource (which should not be confused with a similar legal terminology) encompasses those valuable attributes of the natural world which cannot be, or can be only imperfectly, reduced to individual ownership and therefore do not enter into the processes of market exchange and the price system. It should be noted that this concept is inherently a social rather than a natural science one, but that the resources to which it relates are normally attributes of the natural world rather than the direct services of human beings. Notable among such resources are the air mantle, watercourses, complex ecological systems, and at least certain attributes of space. The last include the visual properties of landscape and the radio spectrum, among others.

The one main feature which all these common property (or, in our context, environmental) resources have in common is that they are subject to congestion. At some low level of use, an additional user of the resource may impose virtually no cost on others. A point is reached, however, where an additional user will cause others to have to incur additional costs or suffer disutilities associated with congestion. When this stage is reached, what economists call an externality or spill-over effect occurs. In other words, a particular user does not take account of the cost he imposes on others when he decides to use the common property resource. Many instances of this surround us--environmental pollution, mutual interference of radio signals, congestion on public roadways and in public recreation areas, jet plane noise, and scarred landscapes, among many others.

Our usual mechanism for limiting the use of resources and leading them into their highest productivity employments is the prices which are established in markets through exchanges between buyers and sellers. For common property resources this mechanism does not function, and they must become the focus for collective on public management, unless they are to be severely overused and misused. This idea has been well developed in the economics literature with respect to particular resources like ocean fisheries. How pervasive common property problems have become has not been widely appreciated by economists, however -- at least not until recently.[1]

## Strategies for Water Quality Management in the United States

Let us turn to an area where I believe that research has already laid a reasonably satisfactory groundwork for implementing the type of strategy outlined above. This is the area of water pollution control. In my opinion our present strategy in this area does not have an orientation which will lead toward effective, efficient, and continuing management of the problem.[2]

What I take to be the present strategy of the federal government for achieving water pollution control in the United States is based on two main elements. The first is financial support for the construction of municipal waste treatment plants. Such support started with the Federal Water Pollution Control Act of 1956 and has continued at higher levels of authorization since then. The 1966 Act authorized $3.4 billion for municipal sewage plant construction grants over the period 1968-71. Under the Act it is possible for municipalities to cover up to 55 percent of the construction costs of waste treatment plants from federal grants.

The second element in our pollution control strategy was instituted by the Water Pollution Control Act of 1965, which required that all states set water quality standards on their interstate and boundary waters. These standards were to be completed and reviewed by the Secretary of the Interior by mid-1967. Understandably enough, there were some delays, but the required standards are now for the most part in existence. The standards were to be accompanied by a proposed program for achieving them, which could then be used as a benchmark against which to judge the need for federal enforcement actions. Actually, while the federal government has had authority to bring enforcement proceedings against interstate polluters in the past, this power has been used only to a very limited extent.

Without in any way denigrating the great and sustained efforts made by Senator Muskie and others to provide us with effective pollution control legislation, I think it is fair to say that the results of our pollution control strategy up to this point have been disappointing to many. The construction of municipal treatment plants has been lagging partly because federal appropriations have fallen far behind authorizations (the authorization for 1970 is $1 billion and Congress has appropriated 800 million), and many people assert that municipalities are holding up construction until federal funds become available. It is hard to say why federal enforcement powers have not been more effective, but possibly it is because of the difficulty and cost of mounting effective enforcement proceedings, as well as the political power of the larger industries. Our record of trying to impose direct federal regulations on large industries has been dismal.[3]

Another government report by the General Accounting Office has provided a rather devastating critique of the present strategy, based primarily on the scattershot way in which support has been provided to municipal treatment plants, the poor operation of existing plants, and the overwhelming growth of industrial discharges.[4] In every major river system studied by the GAO, the conclusion was the same: We have failed to mount a significant attack against the major contributors to pollution. Relying exclusively on the tool of enforcement to remedy this situation would, I am sure, be awkward, unpleasant, expensive, and effective at best only in a static and short-run sense.

As part of our subsidy-enforcement strategy, many bills have been introduced in Congress to provide federal subsidies for the construction of industrial waste treatment plants. These proposals have for the most part so far not been successful. From the point of view of trying to achieve an efficient as well as an effective pollution control policy, this may be regarded as fortunate. For reasons that I will discuss further later, subsidies for industrial waste treatment would tend to be less efficient than incentives to adopt other waste reduction procedures, such as recycling and by-product recovery. Moreover, they would have the unfortunate effect of diminishing the extent to which costs of using the common property resource are reflected in the goods which consumers buy, thus leading to too much consumption of them relative to their social cost of production. In addition to considerations of efficiency, many people also regard it as just or equitable that those industries and consumers who use common property resources to the detriment of others bear the cost of doing so.

Unfortunately, a certain amount of subsidy has already crept into the system. Some industrial plants are connected to municipal systems and can benefit from the subsidies to municipal treatment plant construction. Furthermore, the tax reform bill recently passed by Congress would provide for five-year tax amortization of pollution control facilities and would, according to the testimony of Stanley Surrey before the Joint Economic Committee, cost the government $400 million a year in foregone revenue.[5] In addition to the points already made about the inefficiencies of subsidies, a weakness of rapid tax amortization is that it cannot help those marginal firms which often serve as the excuse for subsidy arrangements. Tax writeoffs would seem to be a particularly perverse way to try to deal with the situation. They have the effect of providing most assistance where it is not particularly needed and, unless counteracted by other provisions, letting die the industrial plant where assistance might be justified. Subsidies, of course, do have the politically attractive feature of spreading burdens so widely that no individual has an incentive to complain very loudly. If they can be hidden behind the complexities of the tax system it is even better. When Charles Schultze was Director of the Bureau of the Budget, he had a sign hanging in his office which said, "If you can't solve the problem, subsidize it." There is an unfortunate amount of truth in this slogan.

Several years ago, I proposed an alternative strategy for dealing with our national water pollution problems.[6] This proposed strategy was also based on two main elements. The first rests on the concept that the waste discharger should insofar as possible bear the damages his waste disposal activities impose on the common property resources of society, and the second recognizes that in many of our highly developed basins, where pollution problems are concentrated, great savings in costs can be obtained by the implementation of a systematic and well-integrated plan for water quality management on a regional basis. The latter would contain elements other than just the treatment of waste waters at particular outfalls.

With respect to the first element, I think we must devise ways of reflecting the costs of using resources that are the common property of everyone, like our watercourses, directly in the decision-making of industries, local government, and consumers. The capacity of our rivers for assimilating waste is a valuable asset, and these rivers have alternative uses which conflict directly with waste disposal. Because our property institutions cannot adequately be applied to resources like watercourses, they are essentially unpriced and treated as free goods, even though they are in fact resources of great and increasing value in the contemporary world. This unhappy situation cannot be remedied unless we move toward the implementation of publicly administered prices for waste discharge to watercourses and for the use of other common property resources.

Accordingly, one element for water quality management is a system of what I have termed "effluent charges." The proceeds from such charges would yield a rent on a scarce resource to society which would be used in various ways, including further measures to improve water quality, as discussed below. Also, and even more importantly, the effluent charge would provide an incentive toward conservation in the use of the watercourses for waste discharge. Careful industry studies have shown that industries can often reduce waste discharges enormously, usually at low cost, if they are given a proper incentive to do so.[7] In many instances, the most effective means for reducing waste discharges are changes in internal processes and recovery and recycling of materials that would otherwise be lost.

Similarly, under our present property institutions, municipalities are paying only part of the social costs of disposing waste to streams, and what they pay is rather capriciously distributed, depending on how much waste treatment they have implemented. A system of effluent charges would give these municipalities an incentive to proceed expeditiously in the treatment of waste. Another point of some importance is that our present policies put heavy emphasis on the construction of plants with little or no follow-through on operations. Experts have pointed out that most treatment plants are operated far below their capabilities. Effluent charges focus on what is put in the stream and thereby offer an incentive for the effective operation of existing facilities. A number of persons have seen fit to dub the effluent charge "a license to pollute," in the hope, no doubt, that this cliche, because of its emotive power, would be regarded as conclusive argument. This mindless cliche has certainly not contributed to the cause of effective water quality management. It is also sometimes said that effluent charges cannot be implemented because industries do not know what they discharge to watercourses. The latter part of this statement is, unfortunately, frequently true. But is it not high time to remedy the situation?

It should be clearly recognized that the present and proposed subsidy arrangements are quite different and, most economists would feel, less desirable in their impacts than effluent charges.

First, the system of effluent charges is based on the concept that efficiency and equity require payment for the use of valuable resources whether they happen to be privately or collectively owned. These prices will be reflected in the industrial producers' decision to install treatment equipment and otherwise reduce the generations of residuals. They will also be reflected in the price of intermediate and final goods, so that a broader incentive will be provided to shift to goods with a lesser environmental cost.

Second, subsidies for the construction of treatment plants do not, by themselves, provide an incentive to take action to control waste discharges. Even if an industry is paid a major proportion of the construction cost of a waste treatment plant, it is still cheaper, from the point of view of the industry, to dump untreated waste into the river. Thus the subsidy arrangement cannot work unless accompanied by enforcement or other pressures on the waste discharger.

Third, to the extent that the subsidy system works it tends to bias the choice of techniques in an inefficient direction. It would provide an incentive to construct treatment plants with federal subsidies even where internal controls would be cheaper.

Finally, the system of effluent charges yields revenue, rather than further straining and eroding an already seriously over-extended tax system. This revenue can be put to useful public purposes, including improvements in the quality of our environment. For an economic point of view perhaps the best imaginable tax base is an activity that causes external diseconomies. Not only does a tax on such a base yield revenue, but it tends to improve the over-all allocation of resources.

Most economists who have studied the matter concluded that there are compelling reasons for favoring effluent charges as one of the cornerstones of effective and efficient regional water quality management. But it may be difficult for particular states and regions to pioneer such a substantial departure from previous practice. The federal government's greater insulation from powerful local interests

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provides an opportunity for leadership. One approach would be for the federal government to levy a national effluent charge on all waste dischargers above some minimum amount. The charge could be based on a formula similar to those that are used in the Ruhr area of West Germany or one of those used by certain U. S. municipalities in levying sewer service charges upon industry. This charge could be considered a minimum which could at discretion be exceeded by a state or regional agency having responsibility for water quality. Revenues obtained by the federal government could be made available for purposes of financing the federal program, with the excess turned over to other governments of general jurisdiction, or, and I think preferably, the revenues could be used to establish regional agencies for the management of water quality, which are the other element in my proposed strategy.

Research on the management of water quality over the past several years has clearly shown that major efficiencies can be obtained by the implementation of systems on a regional basis. In addition to the standard treatment of waste waters, such management systems could include a number of other alternatives closely articulated in planning and operation. These could include riverflow regulation, putting air directly into streams, brief periods of high-level chemical treatment during adverse conditions, and others. Studies of the Potomac, the Miami of Ohio, the Delaware, the San Francisco Bay region, and of other areas have shown beyond question the economies to be realized by this kind of regional approach. It appears that such an approach can only be effectively implemented by a regional river basin agency having the authority to plan, construct, and operate the necessary facilities. Again, there is a role for federal leadership in the establishment of such agencies. So far, tendencies to support such an approach at the federal level have been minimal.

The federal government could, of course, take direct action. It could set up regional agencies for the management of water quality or water resources. These could be separate entities, like TVA, or regional units of federal agencies, as proposed by the first Hoover Commission. There has been so much opposition to arrangements of this nature that it is questionable whether the federal government should or would be willing to move in this fashion. An alternative would be for the federal government to establish incentives and guidelines for the organization and operation of regional management agencies, either under state law or through interstate compacts. An agency with adequate authority to plan and implement a regional management system would be eligible for a grant of funds to support a portion of its budget--to help staff the agency and to make the first data collections, analyses, and formulation of specific measures for water quality management. If the federal government were satisfied that the proposed program and the plan for its implementation satisfied criteria for its efficient operation, the agency might be eligible for a grant to assist it with actual construction and operating expenses. Such a system might appropriately be limited to the early implementation--say, five years. During this period, it would be necessary to work out longer-term arrangements for financing the agency. Clearly, the proposed system of effluent charges could play a major role. Presumably, administration of the effluent charges would be turned over to the regional agencies, with the federal level of charges continuing to be regarded as a baseline. In this manner, regional scale measures would be financed while at the same time providing appropriate incentives to waste dischargers to cut back on their emissions. The federal law might include special provisions for marginal industrial plants which might otherwise go under and where this protection is in the broader social interest. It should be noted that where serious efforts to implement regional management of water quality have been undertaken (as in the Delaware and the Miami river basins), one of the most serious problems has been in setting up adequate financing arrangements.

I have no doubt that federal leadership toward implementation of a system of effluent charges and the creation of regional management agencies can put us on the path to continuing, effective, and efficient management of the quality of our waters. I believe that this approach merits serious consideration as a strategy for dealing with our serious national water pollution problem.

## NOTES

[1] In this connection, see Allen V. Kneese and Ralph C. d'Arge, "Persuasive External Costs and the Response of Society," in The Analysis and Evaluation of Public Expenditures: The PPB System, a compendium of papers submitted to the Subcommittee on Economy in Government of the Joint Economic Committee (91st Congress, 1st Session, 1969).

[2] Most of the points in this section are discussed in more detail in Allen V. Kneese and Blair T. Bower, Managing Water Quality: Economics, Technology, Institutions (Baltimore: Johns Hopkins Press, 1968).

[3] For a recent discussion of this point, see "Economic Analysis and the Efficiency of Government," Report on Economy in Government of the Joint Committee (Joint Committee Print, 91st Congress, 2nd Session, February 9, 1970), p. 35.

[4] See "Examination into the Effectiveness of the Construction Grant Program for Abating, Controlling and Preventing Water Pollution" (Report to the Congress by the Comptroller General of the United States, November 3, 1969).

[5] "Economic Analysis and the Efficiency of Government," op. cit., p. 91.

[6] Allen V. Kneese, The Economics of Regional Water Quality Management (Baltimore: Johns Hopkins Press, 1964).

[7] See, for example, George O. G. Lof and Allen V. Kneese, The Economics of Water Utilization in the Beet Sugar Industry (Baltimore: Johns Hopkins Press, 1968).

# THE FEDERAL POWER TO PROTECT THE ENVIRONMENT

Albert J. Rosenthal*

It is the purpose of this article to examine various ways in which the federal government can compel or induce compliance with environmental standards. Accordingly, some provocative areas of inquiry, such as those pertaining to the substantive standards to be set or the process by which such decisions are to be made, have not been discussed. Since the focus is the enforcement role of the federal government, it also seems necessary to forego consideration of many interesting questions concerning the possible role of private litigation in protecting the environment.

Assuming, therefore, almost plenary power in the federal government to legislate for the protection of the environment, we must turn to the techniques which can be used to accomplish this purpose--the various carrots and sticks available to induce or compel compliance with the government's decisions in this area.

Good intentions alone will not be sufficient to save the environment. Pollution will not be ended through individual housewives rejecting detergents containing phosphates, college students refusing to buy beer in throwaway cans, motorists insisting on lead-free gasoline. Nor is any major contribution to the solution likely to be found in voluntary measures on the part of public-spirited business concerns. In most situations, under current rules of the game, it pays to pollute, and the company that increases its expenses substantially to avoid doing so will generally find itself at a competitive disadvantage. On the other hand, if all firms were subjected to the same regulations, all would have an incentive to comply, especially if it becomes sufficiently expensive to harm the environment, sufficiently cheap to preserve it, or a combination of both.

## DIRECT REGULATION

### A. Types of Sanction

Thus far we have had only a trickle of enforcement contrasted with torrents of pollution. While no devices to compel compliance can succeed in the absence of a national commitment to save the environment, there is reason to hope that such a commitment will be forthcoming.

The most obvious way to discourage any kind of conduct deemed undesirable is to prohibit it and to make it painful for anyone who violates the prohibition. There are a number of traditional legal devices which can be used for this purpose. If applied in cases of damage to the environment, however, some of these sanctions may not work well.

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Reprinted by permission of the Southern California Law Review excerpted from, "The Federal Power to Protect the Environment: Available Devices to Compel of Induce Desired Conduct," Southern California Law Review XLV (Spring 1972), 397-450. Some footnotes omitted.

## 1. Criminal Prosecution

Perhaps the most direct sanction is to make pollution a crime. Despite the emphasis in state anti-pollution legislation on criminal, as opposed to other types of sanctions, criminal prosecutions have seldom been used effectively in the enforcement of environmental protection laws. There are several possible explanations.

First, if anything more than a small fine (analogous to that levied for a parking violation) is to be imposed, there has been a traditional requirement of mens rea.[1] That is, to impose a substantial prison term, willfulness or at least negligence, must generally be proven beyond a reasonable doubt.[2] Since the most important polluters are likely to be large business concerns, it will often be impossible to prove the personal culpability of individual officers or employees. (Corporations can, of course, be fined but can scarcely be imprisoned.) The mens rea requirement may not be a significant obstacle, however. It is, for example, not compelled by the Constitution. In its latest expression on the subject, United States v. Freed,[3] the Supreme Court attempted to reconcile apparently divergent earlier lines of cases. Where the criminal statute can be deemed "a regulatory measure in the interest of the public safety[4] (which would seem to cover laws intended to protect the environment) scienter generally need not be an element of the crime. But the other test suggested by the Court--whether the defendant should have been alerted to the possibility that he was committing a crime[5]--is less clear in its implications in environmental cases.[6]

Further difficulties arise in criminal prosecutions. The government will have to prove its case beyond a reasonable doubt, and, because of the privilege against self-incrimination, may have to do so without the benefits of discovery of information known to the defendant. Moreover, if it loses in the trial court, it may not appeal.[7]

There is also the difficulty of establishing an effective level of punishment. One may well doubt the effectiveness of our criminal law as a whole, as well as find difficulty in evaluating its actual deterrent effect. But at least where there is a strong public revulsion toward the offense and the offender, there can generally be a wide range of punishment severe enough to have the maximum deterrent value available through a system of punishment and yet not harsh enough to deter a judge or jury from imposing the sanctions.

This degree of latitude may not be available, however, where criminal sanctions for pollution are concerned. Public opinion has not yet reached the point, in spite of rapidly growing interest in the protection of the environment, where one who murders a lake would be regarded as comparably culpable to one who murders a person. Yet, small fines, on the other hand, simply will not deter large corporations. It is quite clear, for example, that the attempts by Consolidated Edison to reduce its pollution of New York City's atmosphere have not been the result of occasional $25 or $100 fines.[8]

As long as the context appears to be commercial, and the net damage from any act by one polluter is not clearly discernible, the situation may continue to resemble the enforcement of antitrust laws. There, the role of the criminal sanction is negligible,[9] while the injunction, the divestment order and the private treble damage action have all been of much greater significance.[10]

## 2. Civil Penalties

Monetary penalties in a non-criminal proceeding may effectively substitute for prosecution if the latter is merely for the sake of levying a fine. An air quality bill that passed the Senate in 1970 would have included, in addition to criminal provisions, a general authorization of civil penalties of up to $10,000 per day of violation--a sum large enough to give even major corporations considerable pause. This clause did not survive in the Conference Committee, but the statute adopted[12] did provide for stiff civil penalties to back up its motor vehicle emission provisions--up to $10,000 for the manufacture of sale of each noncomplying automobile or motor.[13] There are also provisions for substantial civil penalties in the Water and Environmental Quality Improvement Act of 1970.[14]

Civil penalties may have substantial deterrent value, particularly if they can be imposed administratively. Much can also be said for the technique, previously proposed in a different context, of establishing mandatory cumulative penalties as a means of providing a reasonable and credible sanction.

There is fairly clear authority for the characterization of such penalties as civil. This characterization would allow them to be imposed without the usual safeguards in criminal proceedings, such as trial by jury and proof beyond a reasonable doubt.[15] Nevertheless, there can never be assurance that a sanction so nearly criminal in all but name will not be so regarded, at least for some purposes, by the courts.[16]

3. Injunctions

The most effective remedy against a business concern violating a law, and certainly the most widely used, is the injunction. As a civil remedy it may be granted upon a mere preponderance of the evidence, and although scienter or willfulness may be relevant, neither should be a prerequisite to relief from enviornmental wrongs. While there may, on the one hand, be one or possibly two levels of appeal, a temporary restraining order or preliminary injuction is also possible. If a stay pending appeal is refused, the questioned practices may be brought to an immediate halt.

There is obvious tension between the possibility of immediate injunctive relief, before trial or even ex parte, and the practice of granting stays of injunctions pending appeal. It may be resolved by determining whether the relief sought is against a long-standing abuse, such as the continued pollution of a river, or a projected new affront, such as the dramatic and irreversible desecration of a mountain. Courts are more likely to interpose an immediate barrier to a new rape than they are to a long-continued defilement.[17] Even great difficulty in achieving quick injunctive relief will probably be encountered if the defendant can show the prospect of serious loss, and perhaps even a sharp curtailment of employment in the affected plant.[18]

One would hope, however, that enforcement authorities will be permitted to institute injunction proceedings as quickly as possible. Thus, a recent threat to start an action against the Penn Central Railroad if after six months it was continuing to pollute the Hudson River[19] seems strange. If six months is a reasonable period in which correction may be completed, it would appear appropriate to sue immediately and ask that the court compel the defendant to eliminate the offending practice within six months. Similarly, the shocking delay of 11 years from the start of state efforts, and of five years from the institution of federal charges, until final effectiveness of a court order in the single federal air pollution case brought to judgment[20] suggests that serious attention must be given to the time factor as a major determinant of the effectiveness of the sanction.

Until recently there seemed to be substantial likelihood that if the injunction were to be the principal weapon relied upon, polluters might find it economically advantageous to give no more than lip service to correction and to keep polluting until the last order of the last court was finally affirmed and rehearing denied. But accelerated procedures have at last been authorized, with respect to air pollution, in the Clean Air Amendments of 1970.[21] Similar changes are needed in connection with restraints on other types of environmental insults. With speedier procedures, the injunction can become a truly effective enforcement technique.

A particularly effective variant of the injunction might be the administrative cease and desist order, made available by Congress to a number of federal regulatory agencies but thus far not to those concerned with environmental protection. Typically, Congress authorizes the agency, following notice and hearing, to order cessation of an offending practice. If compliance does not follow, the agency is empowered to petition a federal court of appeals to enforce the order and in such proceedings the findings of fact of the agency are conclusive if supported by substantial evidence.[22] The court order, in turn, has the status of an injunction, and violations may be punished as contempt. Comliance with regulations of the Environmental Protection Agency, and other government commissions responsible for environmental protection, might be both facilitated and expedited if this procedure were made avaliable to them.

## 4. Actions for Damages

The civil action for damages sometimes serves as an effective enforcement device. An action for damages brought by the federal government is likely to run into difficulties in establishing what monetary damage the government itself--as distinguished from its citizens--has suffered. Another approach might be to permit the government to recover for all damage inflicted upon private persons except to the extent that the private persons themselves brought suit. An analogue might be found in the Emergency Price Control Act of 1942,[23] which permitted the government to recover up to treble damages in cases of sales above maximum price levels. Where the sale was for use in trade or business the government's right was immediate; where it was to a private consumer the government could sue only if the consumer failed to bring suit within a specified period. Courts at the time were divided on the question of whether such treble damage actions by the government were to be characterized as "remedial" or "penal," but there was ultimately no dispute that what was involved was a civil action and that the special requirements imposed in criminal prosecutions were not applicable.

Even assuming creation of a sanction of this kind, proof of damage remains a problem. When under the price control laws a seller charged $2,000 for an automobile whose ceiling price was $1,700, there was no difficulty in computing single damages of $300 and hence treble damages of $900. However, how does one measure the harm done to the inhabitants of New York City, or of other downwind areas, coming from a power plant whose stacks gush sulfur dioxide, or noxious particles from an automobile emitting hydrocarbons or carbon monoxide, or from an apartment house incinerator casting up large quantities of soot? Assuming that legislation can affirmatively create actions for pollution-caused injuries, the problems of proof of causation and of damages remain extremely difficult. The civil penalty, on the other hand, may be imposed without such proof; in most instances it would be a far more effective remedy, requiring only a showing that the prohibited acts had occurred or that prescribed acts had been omitted.

## 5. Licensing

Another enforcement device would be to license businesses, with a forfeiture of license to be imposed for certain violations of regulation. Across-the-board licensing was employed by the Office of Price Administration pursuant to an authorization in the Emergency Price Control Act of 1942; all sellers were declared subject to licensing, all were automatically given a license, and licenses were to be suspended for up to a year upon a second offense. This device was infrequently used to control prices, however, and was presumably not thought to be as effective as the available civil and criminal penalties. Its very harshness probably made the sanction unpalatable to the regulators and mental cases, the threatened loss of a needed facility such as a power plant, or the economic fallout from closing down a major industrial establishment, would often discourage any effort to invoke such a power.

Nevertheless, isolated instances of closedown to meet the growing environmental crisis can be found [24] (although not in a licensing context) and such action may be a barometer of a changing public climate and judicial response. The licensing device with its suspension feature may find favor as the crisis deepens.[25]

## 6. Seizure and Forfeiture

Another technique available to the federal government is to take possession of an offending plant and operate it in compliance with environmental standards. Seizure of property in the public interest has most notably been employed in order to compel continued production despite a strike. The same approach could be followed in the case of a particularly flagrant polluter: the government would take over the plant, correct the offending process, and then return the plant, deferring the question of compensation for later litigation in the Court of Claims. To the extent that production could be continued during the changeover, it would be possible to avoid the economic hardship and community resentment likely to follow loss of jobs.

A more drastic form of seizure would be the total forfeiture of the offending plant to the government, with no compensation and no return. Such laws currently authorize forfeiture of property used in committing certain kinds of violations: boats employed in smuggling automobiles used in the dope traffic, distilleries violating the alcohol tax laws, all may be subject to seizure. However, forfeiture is considered a drastic remedy and is consequently not favored by the courts, whose decisions have tended to construe such statues strictly.

Thus, the forfeiture proceeding has traditionally been regarded as a civil proceeding in rem rather than a criminal action. It is grounded in the primitive anthropomorphic notion of endowing objects with personality and attributing responsibility to them. Certainly, an environmental offense might be said to attach to a factory or plant--conceivably, forfeiture might then be invoked by the government, which would take it over with no constitutional obligation to compensate the owners. The burden of managing such a plant might not be one easily assumed by the government, although such responsibility has been accepted from time to time, as in the seizure of alien enemy property in wartime. Thus, forfeiture would serve as a serious threat hanging over the heads of polluting companies (perhaps augmented by officers' and directors' fear of stockholders' actions), but would not result in the loss of the plant's economic contribution to the community.

But the characterization of forfeiture cases as civil actions in rem does not automatically ensure their insulation from at least some of the constitutional safeguards with which criminal proceedings are invested. In Boyd v. United States,[26] the Supreme Court said:

> We are ... clearly of the opinion that proceedings instituted for the purpose of declaring the forfeiture of a man's property by reason of offenses committed by him, though they may be civil in form, are in their nature criminal....

More recently, in One 1958 Plymouth Sedan v. Pennsylvania,[27] the Court held that evidence obtained in violation of the fourth amendment could not be the basis for sustaining a forefeiture. Further, in United States v. United States Coin and Currency,[28] it held the fifth amendment's privilege against self-incrimination applicable to such proceedings and suggested that the due process and just compensation clauses of that amendment might also apply.[29] It is not yet clear whether this approach will be extended to such other requirements in criminal cases as trial by jury, proof beyond a reasonable doubt, and the barring of appeals by the government.

## B. Point of Application

Apart from the question of the type of sanction to be employed, there is a wide range of possible stages at which the selected sanction might be applied. The consideration of where to concentrate enforcement is closely related, of course, to the question of what aspects of the problem are best subject to regulation. This article is concerned with the latter only to the extent that it relates to the former.

For example, while prohibition emission of certain matter into the air or water is one way to curtail pollution, it is not the only way. Regulation, together with enforcement sanctions, may in some circumstances be applied at an earlier stage of a process. For example, control of the sulfur content of fuel oil used in power production has been employed effectively to reduce the emission of sulfur oxides into the atmosphere in New York City[30] and elsewhere. Where such a "toll gate" on the stream of pollution is available, proof of non-compliance is comparatively easy, and almost any of the criminal or civil sanctions referred to above might well prove effective. Sanctions against actual emissions do not have to be dropped--the two techniques are not mutually exclusive--but a limited enforcement budget will stretch much further if a focal point of this sort is available toward which such sanctions can be directed.

As a substantive matter, it is, of course, most desirable that regulations offer the potential polluter the widest possible selection of methods to avoid damaging the environment, allowing him to reach the decision most in accordance with his own self-interest and therefore presumably least wasteful economically. This principle has to be sacrificed, however, in some situations where limited enforcement budgets dictate the application of controls at those points in the process at which enforcement is most feasible and least expensive. Ideally, regulatory decisions should be made first without regard to enforcement problems. At times, however, it may be necessary to consider the ease of enforcement as a relevant factor in shaping the regulatory technique.

Where the source of pollution is not a manufacturing process but a manufactured product, there is again the possibility of control over what is manufactured as an alternative to control over the use of the product. For example, it might be easier to prohibit the manufacture of detergents containing phosphates than to forbid housewives to use them or to require municipalities to install sewage treatment plants to control their effects.

Several such techniques are available in connection with the automobile. Regulation of the design of newly manufactured cars to reduce air pollution affords a partial solution. But since cars that start clean may become dirty and since there are well over 80 million old cars already on the highways, enforcement at the manufacturing level provides no complete answer. Nevertheless, in conjunction with other techniques, such as periodic inspection of old vehicles, it may contribute toward a solution.

Again, control over the fuels used in automobiles--for example, forbidding or imposing additional taxes upon gasoline containing lead--might reduce automobile pollution. In formulating regulations, the technology of both the fuel and the engines would have to be considered. Once decisions were made, however, it might be possible to enforce them by applying sanctions to violations in the manufacture or sale of forbidden fuels; in the manufacture, sale or use of automobiles with forbidden engine design; in the use of an automobile violating emission standards; or in a combination of several of these. A broad spectrum of controls of the foregoing types has recently been authorized by the Clean Air Amendments of 1970.[31]

A range of possible enforcement devices is similarly available in connection with the problems created by packaging materials. Such materials are a primary source of solid waste, and their disposal often results in other types of pollution as well. Paper wrappings or metal, glass or plastic containers which are not returnable or rapidly degradable could be forbidden. The prohibition could be applied to their use at the source, to their transportation in interstate commerce, or (probably less effectively) to the disposition of the product by the last user. Industry-wide prohibitions might diminish the reluctance, for competitive reasons, of a single manufacturer to eschew harmful packaging materials; for example, soft drink and beer companies might willingly abandon throwaway cans and bottles if their competitors were obliged to do the same.[32]

These methods need not be limited to packaging or fuel controls. In some circumstances, a "systems" approach--regulation of all materials or processes used in an entire activity, such as a manufacturing operation or the generation of power--might afford the best or even the only effective method of minimizing environmental damage.

The standard technique of federal regulation is to forbid the movement of objectionable items in interstate commerce. This could be applied to those goods whose inherent properties are not objectionable, but whose process of manufacture causes damage. It could also include goods which could be expected to do harm at a later stage--such as the throwaway beer bottle or the automobile which could be expected to pollute the air.

The most obvious point of impact in most instances, however, is likely to be the emission of pollutants themselves. This is not only a difficult and expensive area to monitor but also it may not be easy to ascertain the effect the individual polluter may have upon the total character of the air quality region or watershed if he is discovered. Thus, where the nature of the problem is such that other points of application are feasible, they should be given serious consideration. There will probably remain, however, a large number of situations in which control over emissions will be the only effective mode of enforcement.

## SUBSIDIES, INCENTIVES AND CHARGES

### A. Grants

Because federal enforcement efforts are still limited, the principal contribution of the federal government has been both the granting of money to finance environmental improvement and the use of its fiscal resources, rather than its regulatory power, to prod the nation.[33] Most frequently these grants go to state and local governmental bodies for construction, control and research--in particular, for municipal sewage treatment plants and similar devices.[34] Grants may be conditioned on compliance with federal standards. Funds made available on a matching basis reduce the net cost to the recipient governmental authority. They also strengthen the hand of those favoring construction of the plants, not only in making them less expensive, but also in permitting use of the argument that these attractive federal funds are ready and waiting and should not be allowed to remain unused or, even worse, go to another community!

Grants may also be made directly to private enterprise in order to assist in the purchase or construction of facilities to reduce pollution. In most cases, economies of scale would favor awarding grants to public authorities rather than to private polluters in the same area. This factor may be pertinent in connection with water pollution and solid waste disposal, but it is unlikely to have any relevance to the air pollution problem.

Giving grants to private concerns to encourage them to cure their own damaging processes raises many other problems. If a finite amount of money is to do the most good, presumably it has to be used to encourage future improvement rather than to reward past accomplishments. Yet, giving grants to such private concerns seems not only to reward the recalcitrant company which has resisted public demands large sums of money to correct its processes before it was either legally compelled or offered any subsidies to do so. More important, there is doubt as to the desirability of having the public finance the cost of correcting the effluence of industrial polluters. Presumptively, such costs should be borne by the users of the products which give rise to them, although there may be instances when it would be appropriate for the general public to bear part or all of these expenses.

A less objectionable private subsidy would provide incentives to concerns that could reclaim the waste products of others but only at a loss. If the cost would be less than that involved in any other satisfactory method of disposal, such a subsidy might be justified. At the same time, government-sponsored research might find ways in which the reclamation process could be made profitable and the subsidies discontinued.[35]

There may be some plants which cannot conform to reasonable environmental standards at any economically feasible price. As previously shown, there is probably no Constitutional requirement to compensate such enterprises for putting them out of business. Nevertheless, taking over such plants, compensating the owners and providing generous termination pay, retraining programs, or both for the displaced employees may be desirable. For a somewhat smaller expenditure, many plants can probably be made to produce cleanly or can be converted into a different type of operation, either under the same ownership and management or pursuant to a government takeover.

## B. Tax Write-Offs and Credits

An indirect form of subsidy that has proliferated in recent years due to its political attractiveness is the awarding of favorable tax treatment. While the impact of various forms of state and local taxation upon business enterprises if often insufficient to play a major part in business planning or to induce construction of what would otherwise be an uneconomical pollution control apparatus, the large federal cooperate income tax (or in cases of individual or partnership enterprises, personal income tax) is of an entirely different dimension.

But such plans as are advanced, as well as those already in effect, offer only modest incentives. The principal forms of tax assistance are either an "investment credit" on the order of seven per cent provision for accelerating depreciation. The former would be pleasant to receive, but will only rarely be decisive in a business decision.[36] Accelerated depreciation, theoretically at least, means no more than deferment of the time when part of a tax obligation is due, rather than complete elimination of the tax. This is the equivalent of an interest-free loan for the amount of tax deferred over the period of deferment, but again, it is not likely to serve as a major incentive. If, through sale or otherwise, the deferred tax may be ultimately avoided entirely or reflected only in a capital gain, the value of the device is augmented for the taxpayer, but still not enough to induce action which would not be forthcoming anyway.

Moreover, tax relief is a most inefficient way of awarding subsidies.[37] The expertise necessary to careful tailoring of incentives to induce the precise action needed is far less likely to be found in the Senate Finance Committee, the House Ways and Means Committee or the Internal Revenue Service than in the congressional committees and agencies of the Executive Branch that have been directly concerned with the substantive problem. Indeed, the result may be to encourage less efficient programs. Many concerns will undoubtedly secure tax relief for action they would have taken in any event. Furthermore, the value of the benefit will be proportionate to the company's marginal tax bracket, a seemingly irrelevant factor. To a company operating at a loss a deduction or tax credit may be completely worthless; yet, some polluters most in need of financial assistance may be in this category.

The device, as a whole, appears quite unlikely to secure the maximum benefit to the environment from the minimum number of dollars. The only argument in its favor is that, through concealment of its true nature, a tax relief subsidy is often politically more salable than an unmarked device.

## C. Loans

Government loans may be a helpful device to encourage businesses to expend funds to control their pollution. If the company's credit were such that it had ready access to capital markets, such a program would add nothing unless the government were willing to offer lower interest rates; in that case, we would have little more than another form of subsidy, measured by the interest differential. Where, however, the company does have difficulty securing private financing, government loans would be useful in filling this vacuum. The loan programs of the Small Business Administration, the Export-Import Bank, and other government agencies, make use of a small portion of the vast power of the federal government to accumulate and disseminate funds for purposes regarded as socially useful.

## D. Research Programs

Much of the federal air and water quality legislation has authorized pollution control research. In appropriate cases, research may be conducted by the staffs of the various governmental departments. More typically, it is contracted to universities, private research organizations or companies involved in the substantive areas under consideration.

Research goals may be diversified. Better and less expensive forms of air and water treatment are an obvious objective. However, there may also be other less traditional directions in which research can be channeled with even more attractive long term potential.

A large proportion of waste products that pollute the water, the land, or the air are concomitants of modern life. To some degree, the creation of such wastes can be reduced or avoided; for example, control over fuels used for power production can eliminate or reduce emissions of sulfur compounds into the air. While research in those directions is important, there will be an irreducible minimum of pollutant emissions about which something will have to be done. Much of the effort thus far has been devoted to finding ways of disposing of such products in the least harmful fashion. Garbage is towed to sea and dumped, rather than dropped into rivers. Nuclear wastes are buried deep in the ground. The unusable heat from nuclear power production is dissipated into the atmosphere rather than injected into lakes and streams. In some cases, little more is accomplished than the substitution of one form of pollution for another, without even the certainty that the new is less damaging than the old.

Some of our other efforts are based on the notion that infinite, rather than finite, receptacles exist for our waste. This is certainly not true. To treat the ocean today as a forever-patient dump for wastes is the precise analogue of the attitude a few decades ago that the air, the lakes and the rivers could take any amount of waste products. Eventually this must cease; although the role of the ocean in the entire structure of life on this planet is not fully understood, the possibility of a disaster of unprecedented dimension by upsetting its life balance ought not to be ignored.

If it is conceded that, as our gross national product becomes grosser and grosser, no place on earth will exist where we will be able to dispose of our waste, the choices would seem inevitably to narrow down to two. We can stop all growth--of population, and of industrial and agricultural production. Or, we can give highest priority to the recycling of wastes. To halt growth would give rise to serious ethical problems. With a large part of this country's populace living below a decent standard of living, it would be callous indeed to adopt a policy of no further economic growth. When the problem is viewed in the context of a much larger world population, much of it barely surviving at the subsistence level, a decision to end economic development would indeed be difficult to defend. Difficult, that is, unless there were clear and convincing evidence that all life might be terminated if such drastic measures were not immediately adopted. The knowledge of global ecology has not yet advanced to the point where such predictions could be made convincingly.

But even if it were ethically justifiable to make such a decision, it does not seem politically feasible. Those not sharing in the bounty of modern industrial progress can scarcely be expected to accept permanent barricade against the opportunity to raise their standard of living, unless the more affluent were willing to bring their own level down to that of the poor--a decision which, on any wide scale, is utterly inconceivable. Even if the United States were willing to put a moratorium on its own growth, the rest of the world would most certainly follow its own course.

An alternative would be to accord a high priority to research into ways in which waste products can be recycled and, particularly, ways in which this can be done at a tolerable cost. Most of the products that pollute the air and water, as well as solid wastes, have some potential commercial value. Although usually not worth the cost of recapture, neither are they utterly valueless. Many of them also contain elements in comparatively short supply which one day will undoubtedly be needed. If someone were tomorrow to develop a way to shoot all of our pollutants into outer space (perhaps using nuclear waste as the fuel?), despite the immediate attractiveness of the idea, cooler heads would probably decide that the irrevocable loss of these materials to humanity ought to be avoided.

Reclamation of some pollutants has been economically successful. Municipal sewage has been turned into salable fertilizer. Fly ash gathered from smokestacks has been made into cinder block and other useful construction materials. Solid wastes have been compressed into useful land fill (though at times creating fresh problems involving water pollution and marine ecology). Steel, aluminum, glass and paper can all be recycled. Even excess noise might be sold to discotheques. The sulfur emitted in paper manufacturing might be regarded as a low grade ore, under present technology too costly to refine but potentially reclaimable at a profit at some later stage of technological development.

Thermal pollution from power plants involves the dissipation of heat of a grade too low to be commercially useable, thus presenting the unpleasant choice of either spoiling our rivers, changing the local atmospheric climate or curtailing total power production. Research devoted to finding ways to utilize this heat for economically viable purposes might afford the opportunity to escape choosing among any of these unattractive alternatives.

Even if research did not lead to a profitable use of waste, if it gave rise to a use which was only marginally unprofitable it could permit the institution of subsidies at a lower level than would otherwise be required. Furthermore, research should not be limited to technological areas; related studies of potential markets, labor supplies and the like are also needed.

In short, there are a number of different aspects of the pollution problem on which research would be appropriate and where results outweighing by many times the cost of the research might reasonably be hoped for. While the proposition that the problems generated by technology may be cured by more technology is far from self-evident, increased use of research appears to offer the only reasonable alternative to the otherwise unpalatable choice of answers to our present environmental crisis. In our society, the federal government is by far the largest potential source of the funds needed for this purpose.

## E. Artificial Government Markets For Waste

Related to the foregoing suggestion is the idea that the financial power of the federal government can be employed to provide markets for waste products unless and until ways are found to dispose of them profitably. In many circumstances, the cost to the government of buying, processing and disposing of these products would be substantially less than either the cost of replacing the process completely or of slowing down a significant portion of the economy. Moreover, depending upon geographical considerations and the expense of transportation, a government marketing program might afford economies of scale which could not be matched by the individual enterprises involved, reducing the loss in disposing of the products or conceivably even turning a loss into a profit.

## F. Differential Taxes

Another technique, suggested to deter pollution or to encourage its avoidance, is to provide a sliding scale of taxes or charges, with the least offensive product or process paying the smallest amount. Examples include President Nixon's proposal of a higher tax on leaded than on unleaded gasoline,[38] and the suggestion of the Council of State Governments that automobile registration fees vary with the amount of pollutants emitted.[39] This device resembles in some respects the proposed "effluent charge," discussed below.

## G. Effluent and Similar Charges

Considerable attention has been given in recent years to the notion of charging despoilers of the environment--especially water--for the pollution they cause.[40] Theoretically, while most costs of production are reflected in the profit and loss figures of the producer and must therefore be given appropriate attention in a cost analysis of a given operation, it has been traditional to treat the cost of polluting the environment as zero, with the entire loss borne either by persons downstream or downwind or by society as a whole. The effluent charge attempts to internalize these costs and impose them upon the polluter in the fashion of the more traditional costs of production.

Such a program has been in effect for a number of years in the Ruhr Valley in Germany and has apparently been marked by considerable success. Charges are proportioned to the quality and quantity of emissions and the proceeds used for large scale purification plants. A business finding its own particular circumstances to be such that it could more cheaply purify its own wastes than pay for its share of the large scale operation would be free to do so. This, in turn, would presumably be desirable since the total burden on the economy would be less.

This scheme obviously involves many problems. It would work more easily with a small river, which could be dammed and gathered into a purification plant and then discharged below. It is not clear that at the present level of technology the lower Hudson or the Mississippi would be appropriate for any such process.

Certain kinds of solid wastes could be treated under a similar program charging pollutors so much per pound, modified where the substances involved were especially easy or difficult to dispose of.

However, it would be more difficult to impose an effluent charge on air pollution. The air cannot be artificially laundered, and it is unlikely that all the smokestacks in a large area could be connected to one central receiving vessel in which purification could somehow take place.

Of course, the imposition of an effluent charge on one type of pollution without corresponding controls (through tight regulation if a charge is inappropriate) on other forms of pollution would serve simply to divert the damage from the one to the other without any necessary gain. If paper mills, for example, were charged for polluting streams but left free to burn their debris, little would be gained from the use of the effluent charge.

Even in the one circumstance where effluent charges are most likely to be useful--the control of water pollution in river basins--many problems remain. There are difficulties in measuring quantities and composition of discharge. Certain types of damage may be beyond the reach of any curative process, so that no charge would be high enough to reflect the harm done. Moreover, river basins suffer not only from waterside industrial plants and sewage systems, but also from many activities far inland, such as agricultural fertilizer, organic waste and pesticide. Problems of measuring the nature and amount of these run-offs from farms, animal feeding grounds and the like would be extremely difficult. Perhaps the notion of the effluent charge could be modified to make it work in such situations by abandoning the attempt to tie the assessed charge to the cost of correcting the payer's effluence. Even if the amount of the charge were not scaled to the cost of repairing the harm, the charge might still be of considerable value (a) in deterring environmentally harmful practices, and (b) in securing funds for correction or restoration.

None of the foregoing, however, is intended to suggest that effluent charges may not be a good solution to at least some of our problems, especially those involving water pollution. More research is clearly needed. It is not necessary to accept the enthusiastic conclusions of the supporters of the effluent charge, some of whom regard it as virtually a total solution for major problems. In many instances it can play a significant role, not in competition but in conjunction with other more traditional regulatory devices. In fact, in some contexts, if effluent charges are going to work at all, they will have to be coupled with effective prohibitions of alternative courses of conduct. In short, the case for effluent charges has been neither proved nor refuted. Until Vermont adopted them in 1970,[41] they had not been tried in this country. Their proponents claim that we have tried direct enforcement, it has failed, and that charges remain the only meaningful alternative. However, the premise of this argument may be questioned, since it can scarcely be argued that we have ever tried vigorous enforcement.

The ultimate question in much of this becomes, "Who will bear the cost?" Economic, political, and ethical considerations have to be taken into account in reaching an answer. Ideally, the users of a product should pay all production costs, including those arising from environmental side effects, which, until recently, have been masked. There are problems of vested interests, however, not all of an invidious nature. Industries and employment are often dependent upon an existing permissive legal structure, and governmental assistance to cushion the shock of change has many precedents. There may also be activities sufficiently important to the nation that some of the cost should be borne by the public at large. In terms of ability to pay, one cannot generalize for all industries to determine whether it is better that expenses be borne by the taxpayers or by the consumers of the industry's products. Perhaps the environmental costs of the production of food, for example, should be borne by those who eat it in proportion to their consumption, rather than by essentially the same people, but pursuant to a graduated income tax, but this proposition is certainly not self-evident. In any event, the loss should not be permitted through lack of attention and inaction to fall upon a relatively small group of happenstantial victims. Political decisions of the highest order are required in the selection among these alternatives. The wider the range of possible devices for deflecting these costs in different directions, the better the basis upon which such decisions may be predicated.

## USE OF THE PURCHASING POWER OF THE FEDERAL GOVERNMENT

The federal government, with an annual budget of over $200 billion, consumes about one-fifth of the nation's products and services. Thus, government procurement standards play a large part in shaping many aspects of American life. For example, even before the regulatory power of the federal government could clearly enforce minimum wage levels in the economy generally or even in the manufacture of products crossing state lines, Congress enacted the Walsh-Healey Act imposing such standards in the performance of government purchase contracts.

Another instance of conscious use of government procurement policies to affect collateral objectives may be found in the continuing effort to prevent distortions in the economy induced by what appears to be a natural tendency for government purchases to be made from big business. Starting with World War II, various government programs have sought to increase the proportionate share of small business concerns in sales to the government. This has been done through a number of devices: the administrative inclusion of "boiler plate" clauses in government contracts requiring prime contractors to subcontract to small business concerns wherever possible, administrative rules inserted in the Armed Service Procurement Regulation requiring contracting officers to deal with small business concerns to the greatest extent possible; and statutory requirements together with the creation of an independent agency in the Executive Branch (the Smaller War Plants Corporation in World War II, the Small Defense Plants Administration during the Korean War, and the Small Business Administration since).

Still another collateral use of the contracting power is found in the attempts to prohibit racial and other invidious forms of discrimination in employment. Again starting in World War II with the Fair Employment Practices Commission, there have been a series of executive orders requiring all government contractors and first-tier subcontractors to avoid discrimination, not only in the performance of the particular contract in question but also throughout their entire operation.

Interestingly, in 1964 when regulatory legislation to ensure fair employment was finally adopted by the federal government, the contracts program was not abandoned, and superficially at least, has since even shown some signs of being strengthened. Exploring the reasons for this may aid the assessment of the usefulness of contract provisions as substitutes for or adjuncts to direct regulatory control of pollution.

The shortcomings of Title VII of the Civil Rights Act of 1964 do not spring from constitutional limitations upon federal control over local employment, but rather from inherent weaknesses in the statute. A cumbersome administrative proceeding was a prerequisite to a civil action for enforcement, moreover, some lower court decisions, since reversed, initially made it appear that the administrative barriers were even more difficult to surmount than has proved to be the case. Secondly, the statute offers no criminal sanctions, but merely injunctive and appropriate ancillary relief (back pay, for example). Finally, the litigation burden was imposed upon aggrieved individuals, which generally meant poor black workers in the South so that, in practice, the major enforcement effort was undertaken not by the federal government but by civil rights organizations, in particular the NAACP Legal Defense Fund. With limited resources, such agencies could concentrate only on a selected group of test cases that might result in favorable precedents, rather than engaging in a vigorous nationwide enforcement program. The statute did permit the Attorney General to bring his own action if there were a "pattern or practice" of discrimination, but until recently this authority was sparingly used. Some assistance has also been rendered to private litigants by the Equal Employment Opportunity Commission, through the release of investigative data and the submission of amicus curiae briefs. Despite these governmental efforts, however, the program has been relegated, in the main, to private enforcement.

The federal contract compliance program, on the other hand, is a government enforcement program. Moreover, it offers an array of sanctions more effective than the injunction (even if sweetened by back pay) provided by the statute. One who violates the executive order and, at the same time, breaches his contract, is subject to the normal array of remedies for breach of contract--cancellation, and an action for damages or specific performance. Even more important, the executive order permits the blacklisting of a violating employer from further government business. In theory, the in terrorem effect of these threats ought to encourage meticulous compliance on the part of all government contractors doing an appreciable amount of business with the government.

With this history in mind, we can approach the question of the use of the contracting power for preservation of the environment. Recent legislative[42] and executive[43] actions have called for industries in federal procurement contracts of clauses forbidding violation of air pollution regulations, and noise levels in contractors' plants are now controlled under the authority of the Walsh-Healey Act. The same array of horrendous consequences as those theoretically applicable in cases of employment discrimination might be imposed upon contractors who broke their word.

Doubts persist, however, as to the effectiveness of this device contracting officers disposed to ignore, or pay mere lip service to small business or anti-discrimination requirements should not be expected to be more zealous in their protection of the environment. In view of the great difficulties in getting federal agencies to pay adequate attention to the environmental damage they themselves perpetuate, there is no reason to be sanguine as to the degree of vigor with which they would pursue violations by their contractors. Much, of course, would depend upon the degree of dedication at the very highest levels of the federal government. If the present surge of interest led to a sustained commitment at the top to take all appropriate steps to protect the environment, enforcement of contract provisions of the type suggested might become meaningful. It is possible that the drive against pollution will be supported by a more solid national consensus than ever was committed to protect small business or to end racially discriminatory employment.

If the contracting power is used in this fashion for environmental protection, there are strong reasons to place enforcement of such provisions in an agency with responsibility, devotion and expertise in the area, such as the Environmental Protection Agency or the Council on Environmental Quality. Furthermore, the process of determining violations by contractors should be made as simple as possible. The success of the Walsh-Healy Act minimum wage regulations compared to the employment discrimination program may be partially explained by the simplicity of ascertaining what wages an employer pays as opposed to the difficulty of proving racial discrimination in employment. Anti-pollution provisions are likely to fall somewhere between these extremes.

Use of the contracting power, in addition to providing stringent remedies, offers the attractive possibility of operating fairly rapidly with little or no delay for judicial review, with no need to prove violations beyond a reasonable doubt, and with sanctions sufficiently strong to serve as possible deterrents. But there are other potential uses of the government's contracting power beyond the regulatory applications discussed above. For example, the government can enter contracts in order to stimulate new technologies. A substantial portion of the defense establishment's procurement activities are presently in the area of research and development. While "R & D" contracts are usually employed in connection with regular procurement activities as a means of developing the various devices the government hopes to purchase for itself, there is no inherent reason to limit such contracts in this fashion. It would be entirely appropriate for the government to award a contract for the production of a mechanism to be made available to non-governmental users.

For example, the government has entered into contracts for research and development leading to production of a pollution-free automobile or an automobile powered by some device other than the internal combustion engine. The purpose is to encourage either the development of such automobiles for general public sale, or their development even at non-competitive prices for sale to the government itself, or a combination of both. Similarly, contracts can be let for development of cheaper methods of producing lead-free fuels--again with the purpose of ultimate sale to the government, to the public, or both.

Still another use of this technique would involve governmental construction and operation of model plants in industries notorious for the harm they do to the environment. Government-sponsored research might lead to the design of a paper mill, for example, which polluted neither the air nor the water. Whether the end product was a design or a plant, ownership could remain in the government if deemed desirable, or could be sold or licensed to private industry and the techniques made available to others in the private sector.

There is no sharp dividing line between government research and development contracts of this kind and government-sponsored research referred to above. The latter may be handled by way of either contract or grant, depending on circumstances. Whichever is employed, the government would be using its financial resources to assist in the discovery of new ways of protecting the environment.

Yet another way in which the government can influence the environment through its contracting power would be to insert specifications in appropriate procurement contracts which obliged the seller to meet government standards, even if it entailed an increase in cost. For example, a 1970 law authorizes the expenditure of up to 150 per cent of normal prices for government purchases of low-polluting automobiles. The creation of a large government market for a low-pollution car might make its mass marketing financially attractive to industry.

Thus, the government's contracting power offers no panacea. Alone, it probably cannot play the major role in fighting pollution. Nevertheless, particularly in conjunction with direct enforcement techniques, there are ways in which it may be effectively used.

## A WORD ON PRIVATE LITIGATION

While redress for private injury resulting from conduct harmful to the environment has for generations been sought through legal actions brought by these suffering special damage, a new breed of environmental litigation has burgeoned in the last few years. Cases are now being brought by individuals, often as class actions, or by organizations dedicated to the preservation of environmental values, to protect an entire community, from a small village to the whole world. In some cases, the defendants are agencies of federal, state or local government, charged either with actively harmful conduct or with failure to regulate to prevent harm by others. In other cases, the defendants are private--typically companies engaged in or threatening actions detrimental to the environment.

Such litigation can serve as a valuable supplement to governmental devices for the enforcement of laws and regulations. It can also fill the void where public enforcement authorities are remiss. Where the government itself is the offender, it can be an extremely useful antidote to the lack of environmental sensitivity on the part of some government officials. In addition, such actions may serve to direct public attention to the importance of environmental protection.

The magnitude of the task of enforcing the government's own regulations, however, suggests that for the job to be done effectively the major burden must be assumed by the government itself; private litigations lack the resources to act on more than a sporadic, case-by-case basis. And where private actions bypass the legislative and administrative process, seeking to induce the courts to create environmental common law in disregard of extant and prospective laws and regulations, they may prove to be counterproductive. Courts are likely to be poorly equipped or to lack the opportunity--available both to congressional committees and to the agencies charged with implementation of federal statutes--to devote continued attention to environmental problems, to view them from a nationwide perspective, to consider them with regard to all of the potential interests involved rather than merely those represented in the particular litigation, or to acquire the technical expertise so necessary for effective creation of policy.

As indicated above, this discussion does not purport to analyze in depth the actual or potential contribution of the various kinds of private litigation brought to protect the environment; it is intended only to suggest some of the factors pertinent to an evaluation of such litigation in the context of the overall problem of developing ways in which the federal government can effect compliance with environmental standards.

## INTERNATIONAL ACTIONS

Just as the widening impact of pollution has tended to shift responsibility from municipalities and states to the federal government, the danger has become sufficiently global to escape the control of the United States acting alone. But here the analogy ends; much as we may need one, we have no World Government. The next best thing would be the use of multilateral agreements for this purpose.

If, however, such agreements are sufficiently well drafted to promise meaningful improvement, they may run into serious difficulties. Less developed countries may regard environmental concern as a luxury they cannot afford. They might view us as "overdeveloped," in terms of the comparative affluence we have bought at the price of the most extensive despoilment of nature, and have little patience with our efforts to achieve international agreement to protect the oceans and the atmosphere. Their objections might be softened if, along with other prosperous nations, we offered to assume the bulk of the financial burdens involved, including the cost of the major research program suggested above.

## CONCLUSION

The techniques which have been considered to compel or induce compliance are not necessarily mutually exclusive; in many situations they can be used in combination. Moreover, it is desirable to have available a broad range of remedies to permit selection of the appropriate one or ones in each case. Doubts as to the effectiveness of certain of the remedies should not preclude the adoption of the others. We need to experiment with every reasonable device we can invent, in order to develop the strongest possible arsenal of legal weapons; what we are seeking to protect is the well-being, and quite possibly the survival of humanity.

# Notes

[1] *See, e.g.*, People v. Zerillo, 34 Cal. 2d 222, 223 P.2d 223 (1950); Brown v. State, 23 Del. 159, 74 A. 836 (1909); 22 C.J.S. CRIMINAL LAW Sec. 1(e) MODEL PENAL CODE Secs. 1.12, 2.02 (1962). Apart from constitutional considerations, this tradition weighs heavily in persuading courts to read such a requirement into criminal statutes in which it does not appear explicitly.

[2] Some degree of participation by higher levels of management may also be required, for a corporation to be liable for a crime. *See* MODEL PENAL CODE Sec 2.07 (1962); Note, *Antitrust Enforcement against Organized Crime*, 70 COLUM.L.REV. 307, 319 *et seq*. (1970).

There are additional problems peculiar to corporate defendants. Increasingly, corporations are entering into agreements with their officers and directors to indemnify the latter against certain types of claims brought against them. While the corporation cannot sit in prison in place of a vice president who deliberately or carelessly helped to poison a river, might it, consistently with public policy, agree to indemnify him for any fine he had to pay? Even if such a practice were not upheld, it would be virtually impossible to prevent the corporation from indirectly reimbursing its officer for fines he had paid or even for the discomfort of a time in jail, by raising his salary or awarding other fringe benefits after a respectable interval had elapsed.

[3] 401 U.S. 601 (1971).

[4] 401 U.S. at 609 *Cf*. United States v. Dotterweich, 320 U.S. 277, 284 (1943).

[5] 401 U.S. at 608-09. *Cf*. Lambert v. California, 355 U.S. 255 (1957); Robinson v. California, 370 U.S. 660 (1962).

[6] *See generally* Greenawalt, *supra* note 64, at 934 *et seq*.; Packer, *Mens Rea and the Supreme Court*, [1962] SUP. CT. REV. 107; Dublin, *Mens Rea Reconsidered; A Plea for a Due Process Concept of Criminal Responsibility*, 18 STAN. L. REV. 332, 378 (1966). *But see* Gribetz & Grad, *Housing Code Enforcement: Sanctions and Remedies*, 66 COLUM. L. REV. 1254, 1279 (1966) [hereinafter cited as Bribetz]. Where fines are small, tests of constitutionality are likely to be rare.

[7] *See* Note, *supra* note 77, at 319-20.

The privilege against self-incrimination could not, of course, be used by a corporation, nor could an employee refuse to testify on the ground that he might incriminate the corporation or another employee. Corporate records could not be withheld on fifth ammendment grounds. Nevertheless, the possibility that a witness might incriminate himself would in many situations permit him to keep silent.

[8] Small fines may, of course, be effective to deter the small-scale private polluter, such as the casual litterer, the careless motorist or power-boat operator, and so forth.

[9] *See* LANE, THE REGULATION OF BUSINESSMEN 21 *et seq.* (1954); Sutherland, *Is "White Collar Crime" Crime?*, 10 AM. SOC. REV. 132, 136 (1945); Flynn, *Criminal Sanctions under State and Federal Antitrust Laws*, 45 TEXAS L. REV. 1301, 1304-05 (1967); Note, *supra* note 77, *cf*. Kadish, *Some Observations on the Use of Criminal Sanctions in Enforcing Economic Regulations*, 30 U. CHI. L. REV. 423 (1963); Ball & Friedman, *The Use of Criminal Sanctions in the Envorcement of Economic Legislation: A Sociological View*, 17 STAN.L. REV. 197 (1965); H. PACKER, THE LIMITS OF THE CRIMINAL SANCTION 354 *et seq*. (1968)

[10] See Timberg, The Case for Civil Antitrust Enforcement, 14 OHIO ST. L.J. 315 (1953); Note, Increasing Community Control Over Corporate Crime--A Problem in the Law of Sanctions, 71 YALE L.J. 280, 282 et seq. (1961), which presents the view that the criminal fine as presently administered is but "a reasonable license fee" for engaging in projibited conduct.

[11] S.3546, 91st Cong., 2d Sess., Secs. 10(b)-(c) (1970).

[12] The Clean Air Amendments of 1970, 42 U.S.C. Secs. 1857f-1 (1970).

[13] Sec. 205 of the Clean Air Act, as amended by Sec. 7(a) of the Clean Air amendments 1970, 42 U.S.C. Sec. 1858f-4 (1970).

[14] 33 U.S.C. Secs. 1161(b) (5), 1163(j) (1970). See also N.Y. PUB. HEALTH LAW

[15] See Frankfurter & Corcoran, Petty Federal Offenses and the Constitutional Guaranty of Trial by Jury, 39 HARV.L.REV. 917 (1924); Gribetz, supra note 81, at 1284; United States ex rel. Marcus v. Hess, 317 U.S. 537 (1943); Helvering v. Mitchell, 303 U.S. 391 (1938); cf. Duncan v. Louisiana, 391 U.S. 145, 159 (1968).

[16] See Note, Trial by Jury in Criminal Cases, 69 COLUM.L.REV. 419, 427-29 (1969); compare also the judicial treatment of "civil" forfeiture provisions, text accompanying

[17] See, e.g., Boomer v. Atlantic Cement Co., 26 N.Y.2d 219, 257 N.E.2d 870, 309 N.Y.S.2d 312 (1970) in which the New York Court of Appeals refused to enjoin operation of a plant which injured plaintiffs' property through its emissions of dirt, smoke and vibration, on the grounds that the technology which would permit operation without pollution had not yet been developed and that the defendant's investment in and contribution to the economy of the community were large. Damages for permanent reduction in value of plaintiffs' property were awarded instead. Cf. Parker v. United States, 309 F. Supp. 593 (D.C. Colo. 1970) (court order indefinitely continuing a preliminary injunction barring the Secretary of Agriculture from selling timber rights in a relatively untouched area).

[18] For example, a state court fined a major polluter $10,000 for failing to halt the discharge of industrial waste in to the Buffalo River, but refused to enjoin its continued illegal operations because of the adverse effect its closing would have on business in the community. N.Y. Times, Oct. 6, 1970, Sec. 1, at 44, col. 3.

Some present federal statutes also encourage denials of injuctions in the event of economic hardship. See, e.g., with respect to water pollution 33 U.S.C. Sec. 1160(h) (1970); Barry, The Evolution of the Envofcement Provisions of the Federal Water Pollution Control Act: A Study of the Difficulty in Developing Effective Legislation, 68 MICH.L.REV. 1103, 1106, 1120 (1970).

[19] Penn Central was allegedly violating water quality standards by discharging oil from its Harmon, N.Y., yards into the Hudson River. Abatement hearings were scheduled under Sec. 10 of the Federal Water Pollution Control Act, 33 U.S.C. Sec. 1160 (1970). Current Developments, 1 ENVIRON. REP. 101 (1970).

[20] In United States v. Bishop Processing Co., 423 F.2d 469 (4th Cir.), *cert. denied*, 398 U.S. 904 (1970), state efforts at inducing abatement had been initiated in 1959, and formal federal administrative proceedings dragged on from 1965 until 1968 when suit was finally initiated to abote interstate pollution pursuant to the Clean Air Act, 42 U.S.C. Sec. 1857 *et seq*. (Suppl. V, 1965-69). On July 28, 1968, the District Court denied defendant's motion to dismiss the government's suit, and an order to cease operations was affirmed by the Fourth Circuit on March 3, 1970. Certiorari was denied by the Supreme Court on May 18, 1970.

[21] Sec. 113 of the Clean Air Act, *as amended by* Sec. 4(a) of the Clean Air Amendments of 1970, 42 U.S.C. Sec. 1857c-8 (1970).

[22] *E.g.*, 29 U.S.C. Sec. 160 (1970) (NLRB).

[23] 56 Stat. 23 (1942) (repealed 1947).

[24] An eight man investigating team, dispateched by the National Air Pollution Control Administration, pursuant to its emergency inspection program, reported an American Cyanimide plant to be in violation of emission standards. Consequently, the plant was forced to close pending replacement of its sulfuric acid producing units. *Current Developments*, 1 ENVIRON. REP. 55 (1970).

[25] Licensing is being used by the FPC in an experiment of possible substantial significance. The Commission has been attempting to condition licensing of the use of navigable rivers for power production with provisions that would invest it with continuing authority to appraise the public importance of the uses being made by the licensee, and, when desirable, to require the resource involved to be shifted to another use, such as comprehensive waterway development and conservation.

Previous attempts to retain control over private rights granted in natural resources have been largely ineffective. While the user may be regarded as a trustee of the public interest, that interest has generally been left vague and undefined. In particular, courts have been reluctant to find a departure from the public interest where it would undermine the user's large investment. *See* Sax, *Licenses--Restricting Private Rights in Public Resources*, 7 NAT. RES. J. 339 (1967).

[26] 116 U.S. 616, 633-64 (1886).

[27] 380 U.S. 693,697 (1965).

[28] 401 U.S. 715 (1971).

[29] *Id*. at 720-21.

[30] N.Y. CITY AIR POLLUTION CODE Sec. 9.07 (1964).

[31] 42 U.S.C. Secs. 1857 *et seq*. (1970).

[32] The problem of one-way bottles and cans may prove to be more intractable than originally believed. While there would seem to be a wide choice of alternative ways to meet it--outright prohibition, taxation, heavy deposits, bounties for return or reclamation, etc.--each has allegedly revelled serious difficulties when tested locally, and the Administrator of the Environmental Protection Agency has apparently decided to drop attempts to discourage their use. *See* N.Y. Times, Oct. 28, 1971, Sec. 1, at 29, col.1.

[33] *See* W. ANDERSON, THE NATIONS AND THE STATES, RIVALS OR PARTNERS? 175-81 (1955); W. ANDERSON, INTER-GOVERNMENTAL RELATIONS IN REVIEW 43-45 (1960).

[34] Clean Water Restoration Act of 1966, 33 U.S.C. Sec. 1158 (1970). It should be noted that a grant for a municipal sewage treatment plant is in part a subsidy for its industrial users, unless the municipality imposes charges upon such users. In some cases it may therefore be appropriate to condition the award upon the imposition of such charges.

[35] A tire manufacturer has stated that it can use discarded tires in the making of new ones, but not on a break-even basis, and has suggested that a government subsidy or improvements in the process would be necessary if it were to be financially practicable. N.Y. Times, Sept. 27, 1970, Sec. 3, at 1, col. 1. *See also* text accompanying notes

[36] *See generally* Surrey, *Tax Incentives as a Device for Implementing Government Policy*, 43 HARV. L. REV. 705, 713-15 (1970).

[37] For a cogent criticism of tax incentives, *see* Surrey, *supra* note 155. For criticisms directed specifically at the use of tax incentives for pollution control, *see* ABT, *supra* note 145, at 41-46; Roberts, *River Basin Authorities: A National Solution to Water Pollution*, 83 HARV. L. REV. 1527, 1530-37 (1970).

[38] *See* ANN. REP., COUNCIL ON ENVIRON. POLICY 10 (1971).

[39] *See* 30 COUNCIL OF STATE GOVERNMENTS, SUGGESTED STATE LEGISLATION 201 (1971), reprinted in F. GRAD, ENVIRONMENTAL LAW: SOURCES AND PROBLEMS 3-351 (1971).

[40] *See especially* A. KNEESE, THE ECONOMICS OF REGIONAL WATER QUALITY MANAGEMENT 82-98 (1964). *See also* GRAD, RATHJENS & ROSENTHAL, *supra* note 34, at 29; 2d ANN. REP., COUNCIL ON ENVIRON. QUALITY 136-39 (1971).

[41] VT. STAT. ANN., tit. 10, Sec. 910 (A) *et seq.* (Supp. 1970).

[42] *Cf.* Sec. 306 of the Clean Air Act, *as amended by* Sec. 12(a) of the Clean Air Amendments of 1970, 42 U.S.C. Sec. 1857h-4 (1970).

[43] Exec. Order No. 11602, 36 Red. Reg. 12475 (1971).

[44] Compare the careless disregard or conscious subordination of environmental factors in a wide range of federal activities. Among some of the more obvious examples are the federal highway program *Cf.* Citizens to Preserve Overton Park

# EMERGING LEGAL STRATEGIES: JUDICIAL INTERVENTION

Joseph L. Sax*

Environmental problems are not a novelty in American courtrooms. Courts have traditionally abated pollution as a nuisance, and it is quite common for public agencies to obtain judicial enforcement of their orders regulating the use of land, water, and air. In the last few years, however, a new kind of litigation has developed which portends a dramatically different role for the judiciary: The plaintiffs are usually private citizens rather than government agencies; and they sue to enforce rights which they assert as members of the general public, not as property-owners seeking to protect conventional economic interests. Moreover, the governmental agencies which are supposed to be protecting the public interest are often themselves cited as defendants.

Such citizen-initiated litigation is typified by suits against highway departments challenging the necessity or location of a proposed road;[1] actions by local citizens against the United States Forest Service challenging its management of public lands;[2] and suits to enjoin offshore oil-drilling[3] or a proposed airport extension[4] which, it is alleged, will adversely affect scenic or wildlife resources.

In the past, such cases were routinely dismissed at the outset, both because the government was immune from suit and because it was said that private citizens had no "standing" to represent the public interest.[5] The so-called sovereign-immunity doctrine--based largely on the ancient notion that "the king can do no wrong"--has long been discredited as a viable legal theory, and has gradually (though not yet fully) dissipated as an effective defense.

The "standing" doctrine has only recently come under full-scale attack, but it, too, is rapidly losing ground. Courts used to accept unquestioningly the assertion that if citizens were allowed to sue simply as members of the public, the way would be open to a plethora of crank suits. And such suits were thought unnecessary because public officials stood ready to vindicate the public interest. Judicial attitudes toward standing have changed markedly in the last few years. In a recent case, in which local citizens intervened to challenge a radio license renewal by the Federal Communications Commission, the court said:[6]

> The theory that the Commission can always effectively represent the listener interests. . .without the aid and participation of legitimate listener representatives fulfilling the role of private attorneys general is one of those assumptions we collectively try to work with so long as they are reasonably adequate. When it becomes clear. . .that it is no longer a valid assumption which stands up under the realities of actual experience, neither we nor the Commission can continue to rely on it. . . .We cannot fail to note that the long history of complaints. . .had left the Commission virtually unmoved. . . .[T]he renewal application might

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> well have been routinely granted except for the determined and sustained efforts of [the complaining citizens] at no small expense to themselves.

The withdrawal of technical barriers to suit is an important step, but it only sets the stage for the inquiry which courts must undertake once the curtain is drawn back from the process of administrative decision-making. For if it is true that private initiatives are needed to provoke, and at times to displace, administrative agencies charged with protecting the public interest, grave questions are raised about the whole structure of governmental regulation in which we have invested so much of our trust.

If courts were only being asked to correct legal missteps by the agencies in such cases, or to intervene in those rare cases where "arbitrary and capricious action" were said to be involved, the implications would not be so far-reaching. But it is clear that this is not at all the import of most citizen-initiated litigation. Rather, judges are being asked to look behind the exercise of administrative discretion. The charge, bluntly put, is that agencies are not to be trusted to effectuate the public interest; and not simply that they may have misread their statutory mandate in a given case.

It is the agencies' perspective and point of view which is under attack. Judicial uneasiness about this question has become overt in recent decisions. In the radio-licensing case, for example, the court noted that the Commission evinced a "curious neutrality in favor of the licensee," an attitude which put their handling of the matter "beyond repair" by the usual judicial technique of a remand to the Commission for further proceedings according to proper legal standards. The court took the unusual step of revoking the license itself.

Similarly, in recent Massachusetts cases,[7] in which citizens challenged the highway department's decision to take park land for its own use, the court noted a disturbing insensitivity on the part of the highway agency to the state's concern for the maintenance of public parks. The department claimed it had ample authority under a broad statute which authorized it to "improve" the lands of the commonwealth; thus, it said, it could take park land at will, and its decision to do so must be respected by the judiciary. This was too much for the Supreme Judicial Court of Massachusetts. Plainly annoyed by such arrogance, the court responded:

> The improvement of public lands contemplated by this section does not include the widening of a State highway. It seems rather that the improvement of public lands which the legislature provided for. . .is to preserve such lands so that they may be enjoyed by the people for recreational purposes.

The court held that before the highway department could take park land, it had to go to the legislature and obtain specific authorization.

Judicial disenchantment with the administrative process is by no means new, but contemporary concerns about the environment have cast the problem in a new light; for they have brought home to courts the insufficiency of traditional institutions for dealing with the multi-perspective, or ecological, approach which intelligent environmental management implies. Although it was never true that construction of a highway involved only problems of highway engineering, for a long time we seemed satisfied if highway-building agencies acted honestly and according to accepted engineering principles. We asked no more of them, and judicial review of their conduct could thus be limited to the question whether they were violating statutory standards, or acting arbitrarily.

Those narrow standards no longer suffice. We have come to recognize that a highway project goes beyond the problem of facilitating traffic, and may involve issues of housing, water-pollution, demographic patterns, and a host of other questions. Our perspective has broadened, and a number of statutes now require, for example, that project-building agencies take account of local problems and of all reasonable alternatives to the disruption of parks, wildlife and waterfowl refuges, historic sites, and scenic attractions. Even such prosaic matters as dredge-and-fill permit applications filed with the Corps of Engineers must be referred to state and federal fish and wildlife agencies for consideration of their effects on such resources.

The new breadth of vision is commendable; but there is a wide gap between legislative statements of purpose and fulfillment on the part of deeply entrenched bureaucracies. A traditional single-purpose agency--long committed to getting roads built or rivers dredged--does not become an environmental ombudsman by legislative fiat. An agency staffed principally with highway engineers, long accustomed to dealing with certain limited groups in the community, and with a well-established sense of mission and priorities, is not easily transformed. Recent congressional hearings,[8] for example, revealed that long after the enactment of the Fish and Wildlife Coordination Act, imposing upon the Corps of Engineers responsibility for the aquatic environment, even its formal public notices continued to say:

> The decision of the Department of the Army must be based on the effect the proposed work would have upon navigation and not on its effect on property values or other considerations having nothing to do with navigation.

Congressional pressure brought about a formal restatement of function, but one need only visit a local Corps office for a brief chat to wonder how much--in outlook, in perspective, and in fact--that agency has modified its traditional stance as a single-minded, navigation-oriented enterprise.

It is this dilemma which has been brought so forcefully to the attention of the courts in the last few years. And judges, who used to say confidently that they ought not to substitute their judgment for the "expertise" of administrators, have begun to ponder whether and to what extent the expertise of the highway department is to be deferred to when the question is highways versus parks.

The problem is not merely that a traditional agency may lack the range of technical expertise needed to evaluate the diverse issues being presented, or that they may have a sense of mission about their function which tends to make them less than disinterested; or even that they have a history of close dealings with certain interests and industries which represent only one of the perspectives to which they are supposed to be attuned. The new ecological perspective to which they have been asked to respond implements a fundamental modification in the nature of the questions before them. To ask an agency to accommodate the demand for roads with the demand for parks and low-cost housing is to thrust upon them far-reaching public policy choices.

To make such choices, traditional administrative agencies are peculiarly ill-suited. Their perspective, their narrowness of outlook, their considerable insulation from substantial segments of the public--the very things which make them attractive as a source of technical, managerial decisions--become serious detriments in an agency charged with the resolution of large policy issues. It is this problem which judges in the cases cited above intuitively sensed as they rejected the agency's demands for conventional deferential treatment.

The citizen-initiated lawsuit is thus principally an effort to open the decision-making process to a wider constituency and to force decision-making into a more open and responsive forum. The aid of courts is not sought so that judges will substitute their judgment for that of administrators either on engineering questions or on broad policy issues. Rather, the courts are sought out as an instrumentality whereby complaining citizens can obtain access to a more appropriate form for decision-making.

This phenomenon is more easily described than explained. In the Massachusetts highway-park disputes, the goal was to deprive the highway agency of ultimate authority over the policy question involved and to force the legislature openly to consider and resolve the issue presented by the cases. Technically, the court ruled that the highway department lacked adequate authority to seize park land at will. Essentially, however, the goal of the lawsuit was to put the issue before the legislature, where it would have to be confronted and resolved in the full light of public attention. The court thus ruled in the *Robbins* case:

> It is essential to the expression of plain and explicit authority to divert parklands. . .to new and inconsistent uses that there appear in the legislation not only a statement of the new use but a statement or recital showing in some way legislative awareness of the existing public use. In short, the legislation should express not merely the public will for the new use but its willingness to surrender or forego the existing use.

It is with holdings such as this that courts respond to citizen pressures to democratize the decision-making process as it affects issues of environmental quality. The effect of such holdings is suggested by a letter which the plaintiffs' attorney wrote, describing the events which followed the court's decision:

> The Legislature of Massachusetts had more discussion over the Fowl Meadow [the parkland involved in the case] than almost anything else. . .in 1969. . . .After a Herculean effort, the House of Representatives in Massachusetts voted 134-90 to authorize a feasibility study of a westerly route, such as we have been working for. However, our local [highway] Department brought out its troops in the form of at least six men who spent most of the week in the State House and, after reconsideration, obtained a bill for an opposite route by the narrow score of 109-105. The Senate concurred after removing some amendments and the Governor signed the bill. However, the whole subject of super highway construction. . .has been put into the hands of a seven-man commission which is to report whether any new highways are needed. . . .In the meantime, the Governor has stated in public and written us that he will not permit the transfer of the requisite parkland.

To be sure, such litigation does not assure that the advocates of any given position will triumph, or that the legislature will necessarily produce a wise resolution. It does, however, help to move questionable environmental decision-making into a forum where issues of policy must be made and articulated openly, and where legislators must assess the political consequences of taking one position or another. Measured against a system which has been characterized by its responsiveness to particular and limited interest groups, by its single-mindedness and limited perspective, and by its penchant for quiet resolution of potential conflict (often revealed in the attitude that the less the public knows, the less trouble there will be), judicial intervention of the type described above is a significant step forward.

In an area such as environmental quality, where we struggle so much to determine what our goals should be, it is instructive to recall, from time to time, the enormous difficulties encountered in getting public agencies to respond to those situations in which there is a substantial consensus about goals; and in which narrow-interest groups have learned to manipulate the governmental process to their own advantage, to the dismay and detriment of the dominant community. All too often the public is simply presented with a *fait accompli*.

It has been traditional to tell complaining citizens to take their problems to the legislature, or to assume that, ultimately, resort to the ballot box will assure effectuation of the public will. The electoral process, as those who have suddenly awakened to see the bulldozers at work well know, is a very blunt instrument. In the swirling multitude of issues that intervene between periodic elections, it is not easy to cast a ballot which clearly says, "I disapprove your highway policy, approve your stance on foreign aid, and abhor your farm policy." Nor is it very realistic to tell a troubled community to go to Congress and get a law enacted to stop a project which is to go forward within a matter of days or weeks.

We have a great deal of rethinking to do about our *laissez faire* attitudes and assumptions about the *process* of government. Among the very significant matters being raised by environmental litigation is whether, and to what extent, institutions like the judiciary can, and should, intervene to help make that process work more effectively. The technique described above--essentially a judicial remand to the legislature--is one device that is now being tested. In essence, it says, "Yes, the citizens should go to the legislature, but a court order may be needed to assure that they can get there in time, and under circumstances which help to assure that their voices will be heard." It may seem ironic that courts are needed to help make the legislative process work effectively; that citizens must come to the least democratic of the branches of government to make democracy work. But that is one of the intriguing questions now being explored under the label of environmental litigation.

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## Notes

[1] Citizens' Committee for the Hudson Valley v. Volpe, 302 F. Supp. 1083 (S.D.N.Y. 1969); Road Review League v. Boyd, 270 F. Supp. 650 (S.D.N.Y. 1967).

[2] Parker v. United States, Civil No. C-1368 (D. Colo., filed Jan. 7, 1969); Sierra Club v. Hickel *et al.*, Civil No. 51,464 (N.D. Cal., filed June 5, 1969).

[3] Weingand v. Hickel, No. 69-1317-EC (S.D. Cal., filed July 10, 1969).

[4] Abbot v. Osborn, No. 1465 (Super. Ct., Dukes County, Mass., filed March, 1969).

[5] National Parks Ass'n. v. Udall, Civil No. 3904-62 (D.D.C. 1962).

[6] Office of Communication, United Church of Christ v. Federal Communications Comm'n., 359 F.2d 994 (D.C. Cir. 1966).

[7] Sacco v. Department of Public Works, 352 Mass. 670,227 N.E. 2nd 478 (1967); Robbins v. Department of Public Works, 214 N.E. 2d 577 (1969).

[8] Estuarine Areas, Hearings Before a Subcommittee on Fisheries and Wildlife Conservation, Committee on Merchant Marine and Fisheries, House of Representatives, 90th Cong., 1st Sess., Serial No. 90-3 (1967).

# PREFACE TO: V. ENVIRONMENTAL TECHNOLOGY

Environmental technology encompasses everything from sophisticated decision-making models and models of environmental systems (e.g., a watershed) to development of a more efficient routing for refuse pick-up or a new process for treating sewage. While the two articles in this section cannot cover the breadth of the field or broach the important subject of technology transfer, they do provide an insight into some recent developments in the area of environmental information systems, a key area of support to the manager.

In order to achieve better environmental decision-making, information technology needs to be developed to its fullest extent. Information can be defined as the use of data for reducing the level of uncertainty in decision-making. The increased emphasis on research in the biosphere has resulted in an explosion of technical literature, which has increased organizational uncertainty around environmental decisions. Environmental managers are faced with the problem of how to organize and develop an information system, how to monitor program efforts and how to evaluate data for management uses.

One of the first attempts to organize information for use by managers is discussed in "EDMPAS: An Analysis of Environment-Dependent Management Process Automation and Simulation" prepared by the multi-university Gulf Universities Research Consortium (GURC). EDMPAS is an attempt to systematically collect environmental and ecological data, organize it, and make it available in a practical form to managers.

The State of Arizona has taken a slightly different approach in developing an information system to help state and local officials cope with the problem of rapid growth. "The Arizona Trade-Off Model: A Tool for State Growth and Land Use Policy Planning," is explained in an article by "Jick" Myers. Basically, ATOM is a computor-based model designed to test proposed economic development at a specific location against a set of environmental and economic criteria. The model is also able to examine alternative sites. In either case, the model makes no decisions, but rather provides the relevant data to decision-makers for their consideration.

# THE ARIZONA TRADE-OFF MODEL: A TOOL FOR STATE GROWTH AND LAND USE POLICY PLANNING*

Arizona faces several somewhat unique circumstances with regard to development. First, much of the recent growth threatens the very resources that have stimulated economic and demograhpic expansion. Second, the State contains a dual economic structure. The urban areas of the State are rapidly expanding both economically and in population while rural parts of the State contain severely depressed areas and are often characterized by outmigration. The implication of this fact is that Arizona must continue to actively pursue economic development programs. Total disregard or even discouragement of economic growth must not be allowed to occur as long as the depressed areas exist and economic prosperity is desired for these areas. On the other hand, Arizona, which must remain aware of the impact of development programs on the State's economy, must not lose sight of the fact that the nature and quality of its environment is one of its greatest assets and must be preserved.

When the issues of economic growth and environmental quality are considered jointly, it becomes apparent that possible conflicts exist between programs for environmental improvement and policies aimed at stimulating real economic growth. Compromises must be made as policies are adopted and programs implemented. It is also clear that we lack adequate information to assure that policy and program conflicts are resolved in a manner that will maximize the total well-being of the population. The trade-off model approach provides a method for both determining data needs and for providing decision makers with the information required to formulate rational compromise.

## Why was ATOM Developed?

The major objective of the model is to serve as a tool for use by decision makers in evaluating the trade-offs and relationships between potential economic development, environmental quality programs, and trends in the State of Arizona. It was recognized that not all questions concerning these relationships could be completely answered during the initial development of the model. Therefore, the model is constructed in a modular framework so that critical elements can be modified and updated as the state of the art improves. Emphasis also has been placed on developing a model that can be easily manipulated and utilized, thus increasing its potential usefulness by decision makers.

Although the development of the model relating economic growth to environmental quality is the prime objective of this project, other benefits include:

> An examination of how development policies and objectives related to economic growth and environmental quality.

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*Based on a paper by C.W. "Jick" Myers, Arizona Department of Economics Planning and Development and Progress Reports submitted by Battelle Columbus Laboritories. The Arizona model is being developed for the Department of Economic Planning and Development, State of Arizona, by Battelle, The Arizona program is being sponsored in part by the Four Corners Regional Commission and the U.S. Department of Commerce.

- The specification of means for implementing objectives.
- An analysis of environmental impact of specific industries and households.
- An analysis of the economic impact derived from public investment.

## Underlying Concepts of ATOM

The model focuses on economic growth, demographic growth, and environmental quality. Economic growth is measured in terms of changes in employment by industry, changes in the size of the labor force, and unemployment rates. Demographic growth is measured by both migration and natural increase. Evaluation of environmental quality is generated through application of quantifiable as well as subjective measures of ecology, pollution, aesthetics, and human interest. The trade-offs between economic growth and environmental quality are measured in terms of economic opportunity costs. In doing so, the intangible benefits of an improved environment can be balanced against problems caused by economic growth.

Before describing how the Arizona Trade-Off Model operates, it is appropriate to note briefly several of the general economic and environmental concepts on which the model is based.

(1) The economic evaluations or indicators used in this model are based on the concept of changing levels of employment. In other words, the economic evaluation of a particular decision or change in local conditions will be based on the concept of changes in total employment associated with changes in certain selected growth industries which are of most importance to the state's economy.

(2) The economic elements and interactions of the model will be based in part on selected macro- and micro-economic level concepts. Macro-economic factors include such phenomena as matching industry requirements with regional resources and regional development programs. When more precise information is required, micro-economic factors are used. Micro-economic factors utilized include site selection factors, production functions, excess plant capacity, and firm investment decisions.

(3) Development policies and programs evaluated in the Arizona Trade-Off Model are assumed to successfully stimulate the economy to the desired level. The model assumes that once an investment is made, a resulting increase in jobs will not be analyzed in this model. Established mechanisms for stimulating growth will be specified, and the results assumed to follow directly from these programs will then be factored into runs of the model. The model also assumes that, in most cases, some type of new economic development is possible no matter how stringent the environmental standards that are being maintained. Therefore, the model attempts to initiate new activity in sequential order from the most economically feasible to the least.

(4) The concept of environmental quality means something different to each member of society. Therefore, to determine any change in environmental quality and the significance of the change, the environment is defined in a broad context. The impacts of various economic development and environmental policies will be measured in four major categories:

A. Physical-Chemical Pollution - Quantifiable

B. Ecology

C. Aesthetics

D. Human Interest

These categories are incorporated into ATOM as environmental constraints on the type and extent of economic development in Arizona. The constraints can be used to modify the growth that is desired in the state, county, or city, or be used to set environmental policies such as improvement of environment quality in the state, county, or city.

(5) Two types of constraints will be used in the ATOM to assess the feasibility and desirability of economic development. These include physical-chemical constraints and land-use constraints.

(A) Physical-Chemical Constraints

The waste released by an industry or population has impacts on the air, water, and land of Arizona. These impacts are traditionally measured by changes in physical-chemical parameters such as BOD, $SO_2$, SS, etc. which may be allowed to enter the environment and by changing these allowable levels, various environmental policies can be introduced into the model.

(B) Land-Use Factors

The location of an industry or population centers, its design, and the amount of waste released at a site have impacts on the aesthetics, ecology, and human interest of the environment. A detailed site specific environmental analysis can measure the direct impact of these components. Because site specific, geographic detail is not practical at the present level of model development and these categories cannot be related directly to development, as is achieved in the physical-chemical category, a macro-environmental approach is used. This approach incorporates these semi-quantifiable components into ATOM through special land-use factors.

The other three categories of the environment, aesthetics, ecology, and human interest, will be transformed into "land-use" factors. Therefore, a constraint on aesthetics, ecology, or human interest will be implemented in the model by constraining the type of and extent of land use allowed in a particular location in Arizona.

(6) It is important to remember that the model, per se, is oriented toward generating trade-offs as output. Therefore, the central focus of the model is trade-offs, but in the form of output rather than an internal part of the model. ATOM should be viewed as a tool for use by decision makers rather than a definitive, optimizing model. In no way is the model being constructed to yield an optimal solution. An optimizing model implies that the relationship between environmental quality and economic change is known. The focus of ATOM implies that this relationship is not known and that the relationship is not necessarily a constant.

(7) Causality is addressed in those areas critical to evaluating trade-offs between environmental quality and economic change. In particular, causality will be stressed in issues relating economic change to levels of physical-chemical pollution; changes in land use to changes in ecological, human interest, and esthetic environmental issues; and environmental constraints and standards to acceptable levels of economic activity.

## How Does ATOM Work?

In general terms, the Arizona Trade-Off Model is a system of related submodels. Evaluations of economic and environmental change and impact are performed either by means of a dynamic simulation procedure or by evaluating the impacts of projects and policies at a given point in time. Within the overall system framework, some of the model elements are internal and some external to the actual trade-off evaluation. This is most easily explained by references to the flow diagram of the model presented in Figure 1. The three external submodels are concerned with the generation and specification of data, instructions, and parameters of the computer-based trade-off model.* The trade-off section of the Arizona model (elements 5-14 in Figure 1) consists of a set of functionally linked submodels which interact during a particular run or simulation to describe the economic and environmental impacts of a particular policy decision.

## EXTERNAL COMPONENTS

The external components of the system range from a complex economic model to a substantive data bank.

### STEP 1. Public Policy

The first step, shown in Figure 1, is called a public policy submodel. The first task in the use of the model is to delineate specific policy alternatives or methods of implementing them. Numerous state, Federal, and private organizations are promoting economic development while certain of these same agencies and many others are advocating environmental constraints, programs, and objectives. ATOM will identify these Arizona agencies, clarify their missions, and identify the various comprehensive economic and environmental policies of relevance in Arizona.

Given the comprehensive economic or environmental policies and applied objectives, potential programs for implementation to achieve these objectives must be identified. Then, the cost of implementation can be estimated, and, if desirable, placed within a framework of the total budget available. The output of this submodel includes the type of programs to be implemented, the location and the timing of the results associated with them.

### STEP 2. Regional/Industrial Allocation Model (RIAL)

The identification of the industries best suited for various locations is a

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* Unlike the elements of the trade-off portion of ATOM, the external submodels are not operationally linked to each other or other elements.

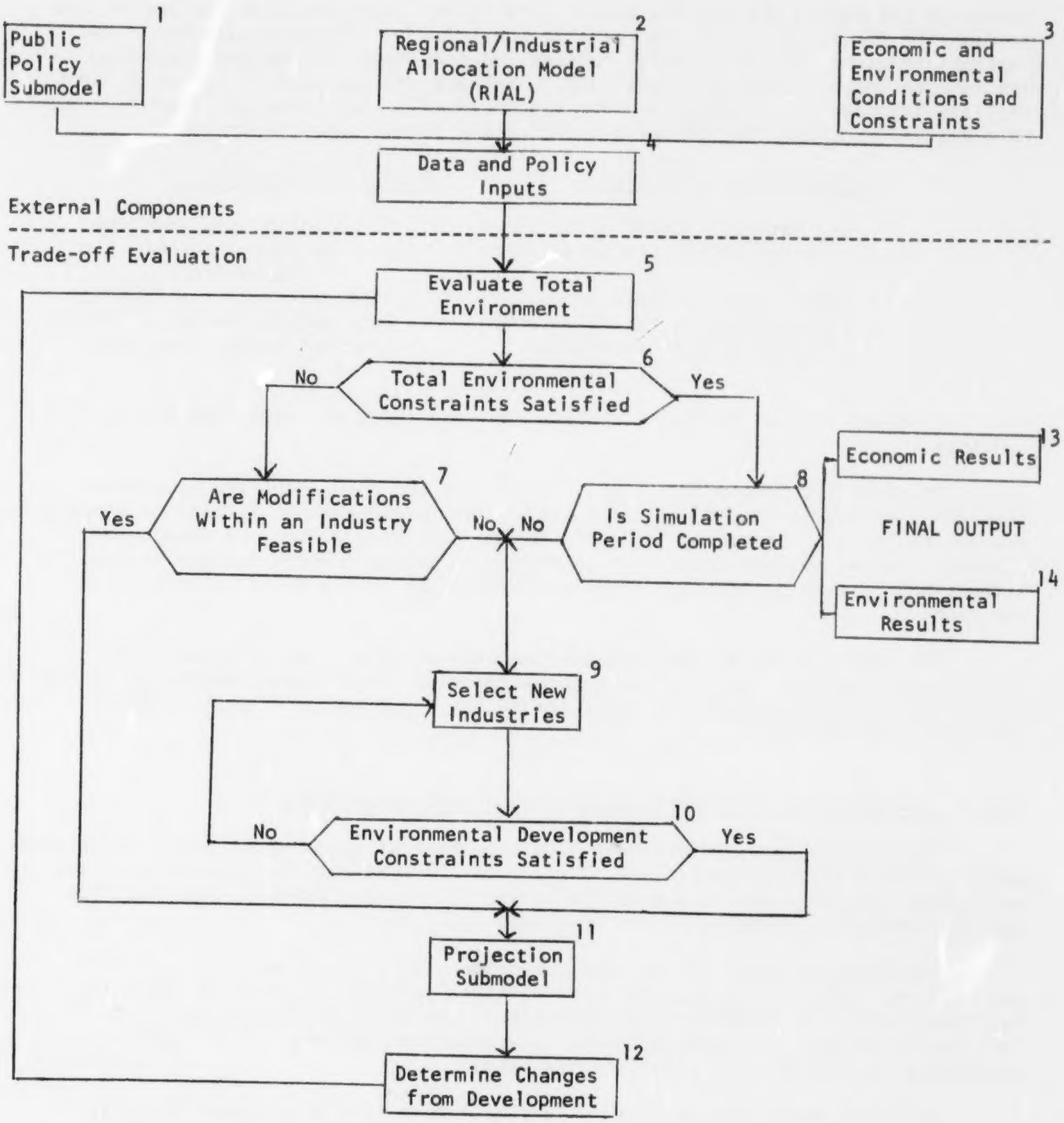
1
Public Policy Submodel
2
Regional/Industrial Allocation Model (RIAL)
3
Economic and Environmental Conditions and Constraints
4
Data and Policy Inputs
External Components
Trade-off Evaluation
5
Evaluate Total Environment
6
Total Environmental Constraints Satisfied
No
Yes
7
Are Modifications Within an Industry Feasible
Yes
No
8
Is Simulation Period Completed
No
13
Economic Results
FINAL OUTPUT
14
Environmental Results
9
Select New Industries
10
Environmental Development Constraints Satisfied
No
Yes
11
Projection Submodel
12
Determine Changes from Development

FIGURE 1. FLOW DIAGRAM OF THE ARIZONA MODEL

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two-stage process in the Arizona model. The initial step involves the use of RIAL to identify industries which are feasible for individual Arizona counties. The Regional Industry Allocation Model relates industry needs to regional resources. Use is made in this model of input-output linkages and the identification of both industry location requirements and the resources of a specific area. Factors used in this analysis include the following industry and county characteristics:

| Industry Characteristics | County Characteristics |
|---|---|
| . raw material supply orientation | . raw material availability |
| . intermediate supply orientation | . intermediate material availability |
| . other supply orientation | . other material availability |
| . intermediate market orientation | . intermediate market potential |
| . consumer market orientation | . consumer market potential |

A ranked list of the most feasible new industries for each location is provided.

The industry feasibility list is only that and no probability measure of likelihood of actual location is attempted. The model makes no attempt to compare the desirability of competing locations for any industry. Proposed development programs must be assumed successful in testing possible impacts because regional science has not yet provided us prescient capacities in the field of industrial location.

The second phase of the industry location process, Step 9 "Select New Industries," examines the likelihood for attracting one of these industries to the county and identifies desirable and suitable locations for a suitable industry (as identified by RIAL).

## STEP 3. Economic and Environmental Conditions and Constraints

The third major external unit is a data base of existing economic, demographic, and environmental characteristics. These data are used both for operation of the analytical procedure and as a base against which to gauge changes resulting from the implementation of policies and programs.

Two types of data will be developed: characteristics of economic activity and regional characteristics. For each possible category of economic activity, data describing its locational and operational characteristics will be input. This would include, for example, number of production workers, skill level, dependance on rail for shipping, and the like.

Existing environmental quality is measured in ATOM by a composite index value derived from the evaluation of sixty-six variables (see Table 1). Each parameter is weighted based upon its importance to total environmental quality. The method begins with 1,000 environmental quality units as representative of a perfect score, although no area would obtain this. Data are then gathered and evaluated for each area of the state. This method is to evaluate environmental quality by quantitative standards. Also, the weighting of different qualities is implicitly a policy variable, i.e., the user may propose alternative weighting arrangements and test the impact of each.

## TABLE 1

### I. ECOLOGY (315 units)

A. Species and Populations (144 units)
  1. Rare and endangered plant and animal species (16)
  2. Productive plant species(16)
  3. Game animals (16)
  4. Other animals (16)
  5. Resident & migratory Birds (16)
  6. Sport fisheries (16)
  7. Commercial fisheries (16)
  8. Pestilent plant and animal species (16)
  9. Parasites (16)

B. Habitats and Communities (96 units)
  10. Species diversity (48)
  11. Food chains (24)
  12. Land use for habitats and communities (24)

C. Ecosystems (75 units)
  13. Productivity rate (25)
  14 Hydrologic budget (25)
  15. Nutrient budget (25)

### II. ENVIRONMENTAL POLLUTION (321 units)

D. Water Pollution (160 units)
  16. Algal blooms (5)
  17. Dissolved oxygen (20)
  18. Evaporation (6)
  19. Fecal coliforms (5)
  20. Nutrients (12)
  21. Pesticides, herbicides, defoliants (8)
  22 pH (8)
  23. Physical river characteristics (6)
  24. Sediment load (15)
  25. Stream flow (20)
  26. Temperature (20)
  27. Total dissolved solids (20)
  28. Toxic substances (5)
  29. Turbidity (10)

E. Air Pollution (40 units)
  30. Carbon monoxide (8)
  31 Hydrocarbons (8)
  32. Particulate matter (8)
  33. Photochemical oxidants (8)
  34. Sulfur oxides (8)

F. Land, Pollution (93 units)
  35. Land use and misuse (31)
  36. Soil erosion (31)
  37. Soil pollution (31)

G. Noise Pollution (28 units)
  38. Noise (28)

### III. ESTHETICS (159 units)

H. Land (25 units)
  39. Land forms (15)
  40. Geologic surface material (10)

I.Air (11) units)
  41 Pleasantness of sounds

J. Water (29 units)
  42. Surface characteristics (25)
  43. Water-land interface characteristics (14)

K. Biota (28 units)
  44. Vegetation (18)
  45. Fauna (10)

L. Man-made Objects (21 units)
  46. Visual
  47. Conditions
  48. Consonance with environment (8)

M. Composition (35 units)
  49. Interaction of land, air, water, and manmade objects (25)
  50. Color (10)

## IV. HUMAN INTEREST (205 units)

N. Educational-Scientific Significance (64 units)
  51. Geological significance (18)
  52. Ecological significance (18)
  53. Archeological signifance (18)
  54 Unusual water phenomenon (10)

O. Historical Significance
  55. Related to persons (11)
  56. Related to events (11)
  57. Related to religions and cultures (11)
  58 Related to architectures and styles (11)
  59. Related to western frontier (11)

P. Cultural Significance (54 units)
  60. Related to Indians (18)
  61. Related to religious groups (18)
  62. Related to other ethnic groups (18)

Q. Mood-Atmosphere Significance (32 units)
  63. Isolation-solitude (8)
  64. Awe-inspiration (8)
  65. "Oneness" with nature (8)
  66. Mystery (8)

Source: Battelle Memorial Institute, Columbus Laboratories

Data describing regional or spatial factors is also prepared, some by county and some by "cell." Information will be entered in the form of State mayors partitioned into about 2,700 rectangular grid cells six-by-ten miles in size. Both economic and environmental factors are entered in the grid matrix.

## Land Use Component

Because of the difficulty of analyzing environmental quality, an environmental evaluation system was developed based primarily on land use descriptions.

Three descriptions of the land use area within each six-by-ten mile cell are used in ATOM. The first is a general classification of surface resources. The second is the distribution of major types of activity or use and the third is a detailed description of attributes of particular sites.

A map of the state of Arizona is overlaid with six-by-ten mile grids. Then, each sixty square-mile area is described in terms of its major surface features. There are eleven classifications used in this description. These include surface water, riparian, urban, cultivated land, coniferous forest, grass land, chapparal and mountain brush. A given sixty-square-mile area might be comprised of thirty-four square miles of urban development, twenty square miles in cultivated land, five square miles of grassland and one square mile of highways. Thus, this method represents a macro assessment of multiple land use features or land resources within a particular cell. The total of these surface resources must be 100 percent for every cell.

The second feature, overlain in map form, is human activities representing either current or future demands upon the use of a given land area. Human activities include such things as urban settlements and their interactions, recreational activity, agriculture or grazing, or perhaps a mineral extractive use. Overlaid to relate to both the surface features and human activities are micro level attributes of land areas. These include such things as land ownership, mineral deposits, the existence of particular game birds or designated habitats, hiking trails, and recreational demand and supply. Many of these micro level attributes are constant within the model; e.g., a site of archeological significance or of particular historical or cultural interest. Other attributes such as recreational demand are calculated within the model and change over time. The calculation of recreational demand is done with a separate model component which provides detailed information on activity days per cell for such things as horseback riding, hiking, picnicking, boating, camping, swimming and fishing.

As activity levels vary within the model, calculations are made of changes in environmental quality. These include the emissions produced by a new industry of a given size or of new concentrations of population, as well as additional use of a recreational area. Environmental quality factors which may be produced in one cell, yet affect quality of the environment in another cell are traced to the point of dissipation. This would be particularly true in terms of water or air pollutants. Ambient air concentrations in a particular cell will change with the introduction of a new manufacturing plant. This change probably will result in the flow of pollutants into adjacent cells. To the extent possible, given existing meteorological information for Arizona, the changes in ambient air quality for adjoining cells or through a chain of cells is followed within the model and new calculations of air quality are made for each of these cells, resulting from the additional activity in the first.

## STEP 4. Data and Policy Inputs

The data input step, listed in the flow diagram as number 4, is not actually a separate model component. It merely illustrates that a selection process is necessary for input into the actual analysis procedure. Those data input will almost always include public policy or program definitions and the most complete description available of both economic and environmental characteristics of a particular area.

Land resource and use data are input in map form, making use of the six-by-ten mile grid cells. The grid size is arbitrary and can be changed if desired. A major difficulty with data used in this type of analysis is that much of the economic information is available only at a county level, whereas environmental characteristics are mostly site-specific. The economic data, therefore, are distributive algorithms where necessary. For the most part, reasonable distributions have been possible on the basis of known concentrations of population or activities.

## TRADE-OFF EVALUATION

The actual evaluation of trade-offs; i.e., the economic and environmental consequences of policy actions, is conducted through the use of an overall framework comprised of several linked submodels. These are in figure 1 as steps 5 through 14.

## STEPS 5 and 6. Evaluate Total Environment/Total Environmental Constraints Satisfied

The first step of the actual computerized trade-off model is to determine if the total economic and demographic development meets specified standards set for environmental quality (see figure 2 ). A detailed picture of the total environment is derived from the sum of all economic and demographic development in a specific cell. Interlocational impacts are also included, e.g., if an upstream plant of some type is causing air pollution, it most be considered in describing the environment of a downwind community.

The simulated success of new economic growth is also tested against a given set of environmental constraints. It is possible to simulate the aggregate impact of a new level of economic activity, and its associated waste generation against both land use and pollution constraints. If these constraints are violated, several options are available. One is to select different industries which would be more compatible with the environment. A second is to modify the existing level of industrial pollution through the imposition of specific controls which can be met by industry, and a third might be to revise certain of the environmental constraints.

One of the important features of the model is an ability to evaluate the efficacy of industrial dispersion as a means of environmental improvement. The regional location model (RIAL) furnished a list of industries most feasible for a given area coupled with the ability to evaluate the environmental impact of different structures. However, it must be emphasized that the model does not address the question of economic efficiency in RIAL, nor does it pretend to suggest that a different locational organization is practical.

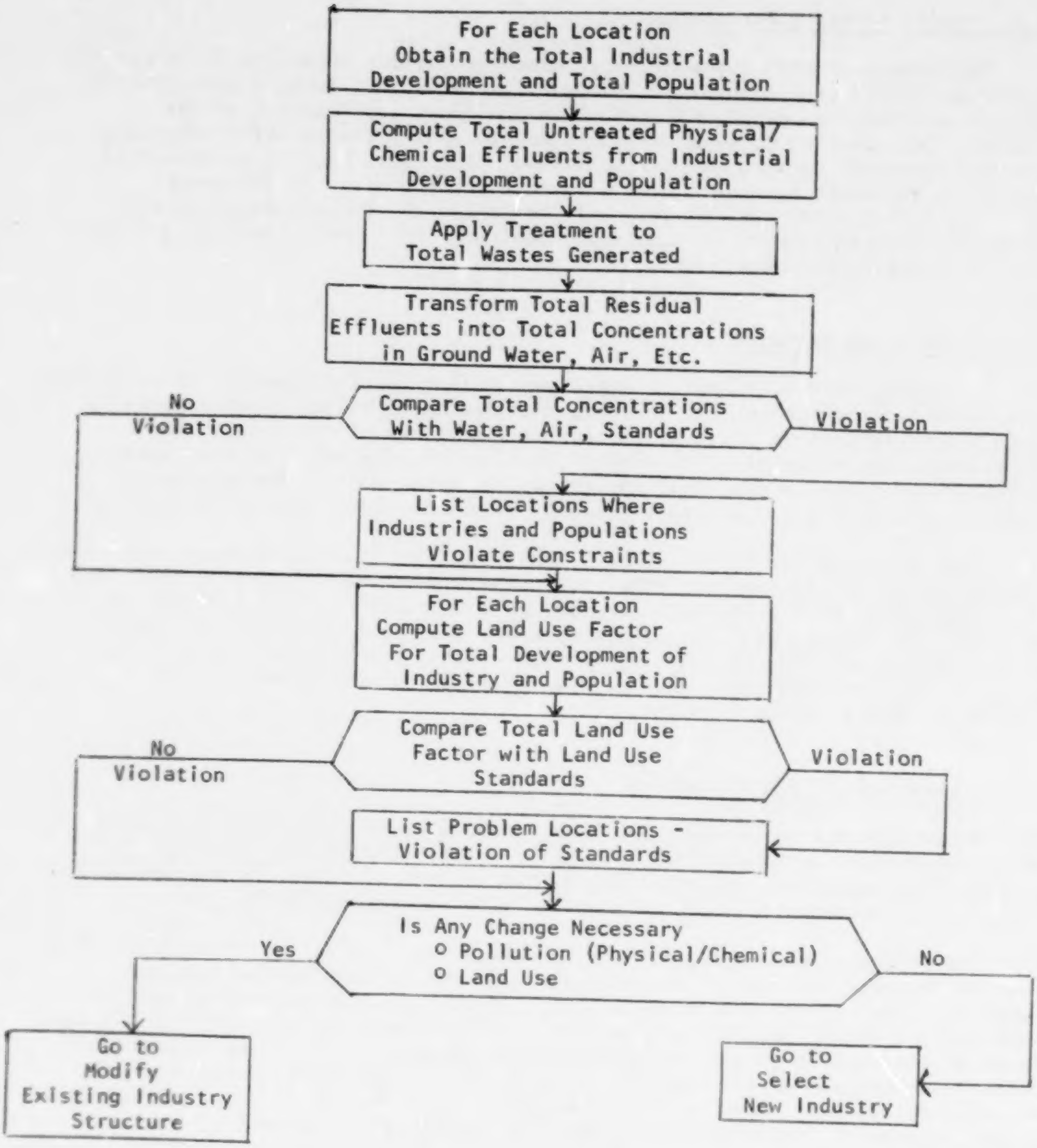
For Each Location
Obtain the Total Industrial
Development and Total Population
Compute Total Untreated Physical/
Chemical Effluents from Industrial
Development and Population
Apply Treatment to
Total Wastes Generated
Transform Total Residual
Effluents into Total Concentrations
in Ground Water, Air, Etc.
No
Violation
Compare Total Concentrations
With Water, Air, Standards
Violation
List Locations Where
Industries and Populations
Violate Constraints
For Each Location
Compute Land Use Factor
For Total Development of
Industry and Population
No
Violation
Compare Total Land Use
Factor with Land Use
Standards
Violation
List Problem Locations -
Violation of Standards
Yes
Is Any Change Necessary
o Pollution (Physical/Chemical)
o Land Use
No
Go to
Modify
Existing Industry
Structure
Go to
Select
New Industry

FIGURE 2. PROGRAM "EVALUATE TOTAL ENVIRONMENT"

## STEP 7. Modify Industry Structures

The purpose of this submodel is to make the changes necessary to industries when the evaluation of the total environment indicates that certain environmental parameters are being exceeded and identifies the types and location of the violation. The question to be answered is how to modify the existing structure so the environmental constraints are satisfied. The first step is to determine if pollution abatement equipment will alleviate the problem. If abatement equipment will not work, the industry will be forced to reduce production and therefore reduce employment. If abatement equipment will work, the cost and the method of financing are analyzed.

## STEP 8. Simulation Periods

The simulation is geared to a ten-year future result; however, it allows the user to select a time period and to trace the impacts of policy changes annually or even quarterly in some cases by successive iterations of the model. As illustrated in the schematic flow diagram in figure 1, the model always repeats the step 5 evaluation of the total environment after a policy induced change. Steps six, seven and eight are then repeated before the final output is produced.

After one complete cycle (steps 5 through 12) of ATOM, a feedback loop results in the execution of the Evaluate Total Environment submodel. Following this step, the question is asked "Is the simulated period completed?" If the 6th year of simulation of a 10-year test has been completed, the model continues to simulate four more annual evaluations. If, on the other hand, the 10th year of a 10-year simulation has been completed, ATOM prints out final output in the form of environmental and economic impacts.

## STEP 9. Selection of New Industries

Once the existing economic and demographic structure has been evaluated in terms of environmental constraints, changes in structure made, or the need for new industries specified, the model begins the process of selecting new industries and activities required to meet the economic development objectives.

The selection of new industries encompasses several tasks. The first is to determine the overall level of new activity required to meet economic growth objectives. The natural growth which will probably occur is determined earlier in providing a set of baseline projections. A difference between this and a target rate of growth results in the need to select new industries from the ranked list previously determined by the Regional Industry Allocation Model. Although this model does not consider comparative advantage, it is a valuable tool in allowing the user to examine feasible alternatives for industrial structure.

A key component of the selection process is determining the best location (by cell) for an industry. Among the factors considered are: labor force; transportation; industrial sites; educational facilities; institutional factors (e.g. taxes; government policies); agricultural potential; and recreational potential. Once the best location is chosen, it is examined to see if that activity violates any environmental constraints, such as land use or air pollution constraints. If any environmental constraints are exceeded, the model attempts to relocate the activity.

## STEP 10. Environmental Development Constraints Evaluation

The objective of this ATOM Submodel is to test for the environmental feasibility of an industrial development suggested by the economic part of the model (Figure 1). It is assumed that, if a development is unfeasible either by its violation of the physical-chemical constraints or land-use constraints, when summed with other developments, it remains unfeasible.

For each industry used in the Arizona model, a profile is developed of the waste that it generates. These raw wastes are then subjected to "treatment" to determine the effluent or residual that would enter the environment. The residuals are then converted into a concentration in the receiving environment--stream, ground water, air, etc. The resulting concentrations are compared to environmental quality standards parameter by parameter to determine if any violations exist. Violations are stored for the next economic evaluation.

Each industry is associated with a land-use factor. This land use is then compared to the desired land use at the particular location. If a violation occurs, it is recorded for the next economic evaluation. Because these land uses are a function of ecology, aesthetics, and human interest, a violation of the land use implies an unallowable impact in these categories of the environment.

## STEP 11. Projection Submodel

This component projects internally consistent sets of demographic and economic forecasts. This latter point is especially important because it produces accurate estimates not only of demographic impacts resulting from some changes in economic structure, but also computes certain secondary impacts and multipliers such as needed for increased employment in trade and services. Output is in terms of population, households, demographic characteristics, and employment by industry.

## STEP 12. Determine Changes From Development

In this part of ATOM economic and regional data is updated in such a way that what occurred in one simulation or run of the model may be entered in the next cycle. A final analysis of each simulation can be made by returning to step 5 and again evaluating the total environment. The model then passes through steps 6 and 8 to the final output section where the results are recorded.

## Final Results: Economic and Environmental

The consequences which result from a particular test situation will be printed out by the model in two basic forms. First, economic changes which result from an alternative policy will be described. This will provide a detailed picture not only of changes in employment but also population and the multiplier impacts which may accompany a given program.

The consequences which result from a test situation in the environmental sector will be described through the use of a special environmental evaluation system that has been tailored for use in Arizona. The impacts of a particular policy will be described in four main dimensions: ecological, aesthetic, social, and physical-chemical. A fifth community may be related to the above which relates environmental consequences to various types of urban and rural situations and social climates. Examples of ecological topics to be examined are small game, and upland birds; examples of aethestics categories to be examined are relief, vegetation types, and scenic areas. The physical and chemical considerations include sulfur oxides and hydrocarbons as well as other factors which are generally quantifiable. In the social and community areas, cultural, historic, and urban settlement patterms will be examined.

There is no attempt within the Arizona model to arrive at some optimal solution by combining the economic and environmental results. It is anticipated by producing an objective and detailed picture of the consequences of a policy decision, described in these two major dimensions, that the decision makers in Arizona will have the type of information demanded and required to evaluate economic and environmental trade-offs.

## Conclusion

This presentation on the Arizona Trade-Off Model is admittedly sketchy and necessarily brief. The model is operational and provides useful information to policy makers in establishing directions. Refinements are necessary, but this would be expected in any new approach to the solution of a complex problem. Success is claimed in terms of devising a rational process for analyzing policy alternatives and providing decision makers with relevant information. The interrelationships amenable to a comprehensive analytical process. Causality is structured into the framework where applicable and it is believed that the Arizona Trade-Off Model, despite its initial limitations, represents a significant breakthrough in fulfilling the planning function. That is, it will give the policy makers useful information about the trade-offs between economic growth and environmental impacts which can be weighted against political and social realities in a rational decision-making process.

# EDMPAS: AN ANALYSIS OF ENVIRONMENT-DEPENDENT MANAGEMENT PROCESS AUTOMATION AND SIMULATION

Gulf Universities Research Consortium*

This paper presents the ENVIRONMENT-DEPENDENT MANAGEMENT PROCESS AUTOMATION AND SIMULATION (EDMPAS) system in sufficient detail to permit its preliminary evaluation. EDMPAS and its major components are described in terms of those characteristics and capabilities which appear to offer unusual or improved support to operational and management elements of environment-dependent organizations.

While emphasis is placed on description of the total EDMPAS system, it is important to recognize that certain of its major software components can be put to effective use immediately as stand-alone subsystems to improve information and data management appropriate to needs ranging from purely scientific to diverse management applications.

## THE PURPOSE AND APPLICATION OF EDMPAS

Through several decades of practice, modern management has developed procedures for the acquisition of data; its conversion into management-pertinent information; and the compression of the synthesized/interpreted product into a form which facilitates rapid management appraisal and decision-making. These procedures and the associated organizational structures and functions are designed to

.. Monitor the basic agency, industry, company, etc. operation -- involving, for example, demand forecast, design, construction, production, distribution, etc. -- and the primary external inputs -- such as financial sensitivities and controls, pertinent technological development, and institutional or regulatory controls; and

.. Implement a management level-to-data collection level closed loop information feedback system that, after a sufficient number of iterations or "practice cycles", provides management with a continuum of compressed information developed specifically for effective organizational operation and informed decision-making.

Modern governmental and industrial management has rapidly integrated the use of computers into its strategy/policy/decision-making process. Essentially all agencies and companies of reasonable size and complexity are using computers in direct support of operational requirements and to provide information for management decision.

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HOWEVER, WHEN ENVIRONMENTAL AND ECOLOGICAL SENSITIVITIES AND RESPONSIBILITIES OF THE ORGANIZATION MUST BE CONSIDERED, THE COMPLEXITY OF MANAGEMENT AND OF THE INFORMATION NEEDED TO SUPPORT MANAGEMENT IS INCREASED WELL BEYOND THE CAPABILITIES OF PRESENT MANAGEMENT PROCEDURES AND THEIR ASSOCIATED AUTOMATED INFORMATION SYSTEMS. The capability to couple the effects of dynamic natural processes (e.g., the effects of environmental mass and energy exchange on pollutant concentration, or rates of living resources production as a function of natural and human processes) and related economic, social and legal considerations into the management process is currently very inadequate because: omplete sets of environmental and related data are lacking; omputer software capable of integrating environmental and related human process information into the data and information management systems currently supporting management procedures has not been made generally available; and he knowledge required for synthesizing, interpreting and compressing interdisciplinary management-pertinent information as necessary to support informed decision-making has not been developed.

A more subtle, but very important, inadequacy of general information management systems AS APPLIED TO ENVIRONMENT-DEPENDENT DECISIONS appears to result from their dependence on statistics as inputs and the use of established probabilities to produce a "most probable" answer to management query. Unfortunately, environmental (and, therefore, environment-dependent social) data is not established with several-decimal-point accuracy; and decisions relative to the environment are made only once (or, possibly, 2-3 times with long intermediate delays) such that probabilities do not apply -- being "right 51 percent of the time" now becomes being "51 percent right", and that is inadequate for environmental decisions.

These deficiencies should not be attacked independently. On the contrary, they are best attacked as a single coordinated effort. Since August, 1971, a multi-university Gulf Universities Research Consortium (GURC) team has been working to overcome these deficiencies. This effort has been directed specifically to the development of software which constitutes the means for effectively coupling environmental and ecological factors into management processes. However, it has been integrated with other GURC programs so that it could be conducted as a coordinated effort involving the acquisition of complete data sets (to the extent that environmental/economic/legal expertise can now define such sets); statistical and functional processing of these data; the expansion and conversion of real data to continuous-process-derived synthetic data for each type of disciplinary information and according to query-determined spatial and temporal coordinates such that interdisciplinary subset-by-subset analysis and correlation is possible; development of a completely flexible interdisciplinary data compiler system permitting immediate access to individual bits, selected subsets or complete files; synthesis and interpretation of data for application to specific real world problems; compression and display of pertinent data subsets; and use of compressed information for the design of improved data acquisition.

Therefore, the development effort has simulated many of the functions in the management information feedback loop process. The GURC team is continuing the development, integration and testing of EDMPAS. Also, in the test phases, it is involving personnel directly involved in environment-dependent problem solution.

The EDMPAS system as described herein is "14 months and $450,000 old"; hence, it by no means provides all of the software for environment-dependent management support. Indeed, except for purely environmental science applications, its full application depends upon its integration with existing archives, general information management systems, socio-environmental models, etc. HOWEVER, IT DOES PROVIDE THE ONLY MEANS thus far revealed to the GURC team in its survey of available data/information management systems for handling the complete spectrum of environmental and environment-dependent disciplines; merging and compressing such data as obtained from disparate data banks; integrating this capability with existing information management systems and their components; and continuously updating and expanding the system without limit and without obsolescence.

Therefore, EDMPAS in its current state of development provides both (1) a significant step forward as evidenced by a stand-alone on-line interdisciplinary information system with real-time capability and (2) an exceptionally effective and flexible base for continuing expansion and improvement.

## THE CONCEPTUAL APPROACH AND DEVELOPMENT OBJECTIVES FOR EDMPAS

### A. Basic Automation and Simulation Requirements

The management of any organization of significant size involves (1) data and information flow from both internal and external sources and (2) conversion of "raw" data into information which has been synthesized, interpreted, and compressed through successive organizational levels for operational and management use. Procedures are gradually established whereby the needed data are either generated or accessed from existing sources and fed through the organization's information flow channels. Such procedures are established through successive iterations, or "trials", wherein both the management query, or information demand, and the information system response to that effectiveness are established. This management level-to-data base feedback system must operate continuously and must undergo some continuous modification to adapt to new requirements for managerial strategy and decision-making.

THE GOAL OF ANY "INFORMATION MANAGEMENT SYSTEM", THEREFORE, MUST BE THE (1) AUTOMATION OF THE INFORMATION FLOW NETWORK WITHIN THE ORGANIZATION AND (2) SIMULATION OF THOSE OPERATIONS WHEREBY DATA IS SYNTHESIZED, INTERPRETED AND COMPRESSED -- I.E., CONVERSION INTO "MANAGEMENT" INFORMATION. As long as one deals with "hard data" only -- i.e., compiled statistics as contrasted with dynamic processes such as those controlling environmental parameters in the management system -- it is probable that many information management systems can accomplish the first of these functions with varying degrees of effectiveness. However, to provide the capability for either management or scientific query of both active and stored data sources of interdisciplinary data (1) on a functional relationship basis and (2) allowing time and space display according to selected grid systems, an EDMPAS type of capability is required. THE COMPLETELY FALSE PREMISE UPON WHICH MANY INFORMATION MANAGEMENT SYSTEMS APPROACH ENVIRONMENTAL PROBLEMS IS THAT (1) A COMPLETE "DATA BASE" EXISTS, (2) THE KNOWLEDGE NECESSARY FOR ITS APPLICATION TO MANAGEMENT PROBLEMS EXISTS, AND (3) ITS COMBINATION INTO A "MANAGEMENT MODEL" CAN BE HANDLED WITH ONE-WAY STATISTICS -- in a manner similar to the computation of a "hit" probability in a baseball game based on the pitcher's ERA, the batter's hitting percentage, right-and-left-hand comparisons, etc. In environment-dependent management, neither the data nor the knowledge has been developed. Not only have there been no accurately recorded statistics taken during hundreds of thousands of games, but almost each game is different so that statistics in the normal sense cannot be generated -- much less the functional relationships required to convert statistics into a valid strategy. Further, the time lags involved in natural and human processes prevent immediate assessment of the strategy. Determining, in even approximate quantitative terms, the effectiveness of pollution control regulation in reestablishing water quality, for example, requires many months or several years. On the other hand, the results of putting in a left-handed pinch hitter are immediately observable, and the average results of such decision are established to three decimal places. Hence, in environment-dependent management, a two-way and nearly real-time information flow automation is required such that the feedback system is affected and SUCH THAT ENVIRONMENTAL *AND* MANAGEMENT EXPERTISE CAN BE BROUGHT TO BEAR ON THE GENERATION OF AN ACCURATE SIMULATION (AND THEREFORE PREDICTION) CAPABILITY. Unlike baseball-type problems, one is *not* making decisions on the basis of unchanging rules and procedures and three-decimal-place statistics. When management decisions are made frequently, and rapid recovery or revision following a "bad" decision is possible, being "right" a majority of the time is usually adequate. In visible environmental problems, *the manager may get only one chance* -- and so may the environment.

It is obvious that automation and simulation of the environment-dependent management system does *not* imply the ultimate elimination of people from the system. On the contrary, only skilled individuals can direct the automation process to achieve management-to-data base compatibility, perform the interpretive function such that data-to-information conversion and compression is possible, and keep the management information feedback loop in adjustment. The most accurate analog, or model, of a system is the system itself; hence, computerized automation and simulation in environment-dependent management must be viewed as a tool which enhances the development of knowledge regarding the interplay between environmental processes and organizational management such that an effective management skill is developed, long-range strategy acquires greater validity, and decision-making becomes more accurate.

At this point in time, it is apparent that the FOCUS REQUIRED FOR ENVIRONMENT-DEPENDENT PROBLEM SOLUTION IS AT THE STAFF LEVEL in the organization. It is at this level that instructions for data acquisition are formulated and data synthesis and interpretation are performed to accomplish the needed data-to-information conversion and compression in response to management query. EDMPAS HAS BEEN DEVELOPED BY ENVIRONMENTAL SCIENCE SPECIALISTS who are representative of those who must accomplish these functions as they pertain to environmental influences on organizational management strategy and decision-making. In carrying out this development, however, test cases were used wherein these specialists were directing a data acquisition effort followed by synthesis, interpretation and compression of information for evaluation and decision concerning specific "real world" environment-dependent problems -- such as the ecological effects of deep water dumping of munitions. Additionally, a clear objective was maintained regarding compatability of the environmental information system with those systems already developed and in use for that part of organizational information feedback systems *not* involving environmental dependence such that subsequent integration with such systems was both possible and easily accomplished.

Similarly clear objectives pertained to the development of an information management system which could automatically (1) access data from established -- and disparate -- archives or data banks, and (2) provide input/output interface with dynamic environmental or socio-environmental computerized models. Because the "executive command" software module of EDMPAS -- Environmental Information Retrieval (ENVIR) subsystem -- accomplishes these objectives, INTEGRATION OF EDMPAS WITH EXISTING MANAGEMENT SYSTEMS SHOULD RESULT IN MINIMUM TIME AND COST AND LITTLE, IF ANY, OBSOLESCENCE OF THE EXISTING SYSTEM.

## B. The Basic Logic Employed in EDMPAS Development

It is pertinent to discuss the logic employed in EDMPAS development in this regard. In the interest of brevity, however, AN EXCEEDINGLY SIMPLIFIED portrayal of "normal" management structure and functions is used. Also, it is useful to project this management procedure in terms of a simplified and generalized management model; however, the model is discussed only to demonstrate the nature of environment-dependent management simulation requirements rather than to imply that such a model is either the immediate objective of EDMPAS or that it is in any way essential to EDMPAS application. On the other hand, an interplay between management models and a "living atlas" type of model input such as EDMPAS would be mutually advantageous -- particularly during their development phases.

Figure 1 presents a simplified management structure which emphasizes data flow and data-to-information conversion. The lines in the diagram represent that data and information flow within the organizational structure resulting from a single query at the manager level; i.e., they indicate the usual "in-line" flow of queries from the top down and return flow of response data and information from the bottom up. The blocks in the diagram represent functions accomplished within the structure whereby data are validated and organized and then, by successive stages, synthesized, interpreted and compressed for the next level of management. The dependence on both internal and external sources of data and information is included to emphasize dependence on the acquisition of data from disparate sources.

It is pertinent to note that data "processing", "storage and retrieval", "display", etc. do not appear in Figure 1 as functional blocks. Such procedures are the means for automation of the data and information flow process at all levels; hence, the lines are "circled" in Figure 1 and "connected" to a Data Information Flow Automation "circle" to indicate either actual or potential automation wherever lines appear on the diagram.

The AUTOMATION of the data and information flow process by data "processing", "storage and retrieval", "display", etc. refers, then, to "computerizing" the lines in the diagram. The SIMULATION of the management process requires computerization of the functions performed by the blocks in the diagram. In general, this means the generation of "table functions", "control functions", "correlation instructions", etc. for correlation, synthesis, display, etc. which simulate the information conversion and compression functions in the system. Such simulation is now generally limited to enhancing the human management system in terms of synthesis and display for human interpretation and guidance. That is, it should facilitate the expert appraisal of large, complex and interrelated quantities of data and information. This permits, then, a series of queries and responses of increasing complexity and sophistication which lead to valid interpretation followed by meaningful compression. In this regard, the current status of environmental know-how is such that even scientific query of a bank of environmental data is generally either inaccurate or inadequate until a series of queries interspersed with quick graphic answers has led the inquirer to "ask the right question". This problem is multiplied many-fold when the query attempts to relate environmental to corresponding management elements of the problem.

Organizational structures as shown in Figure 1 are sufficiently standard and familiar that only certain specific points are noted: Data is fed into the system at all levels of the structure; Data compression and conversion to information occur

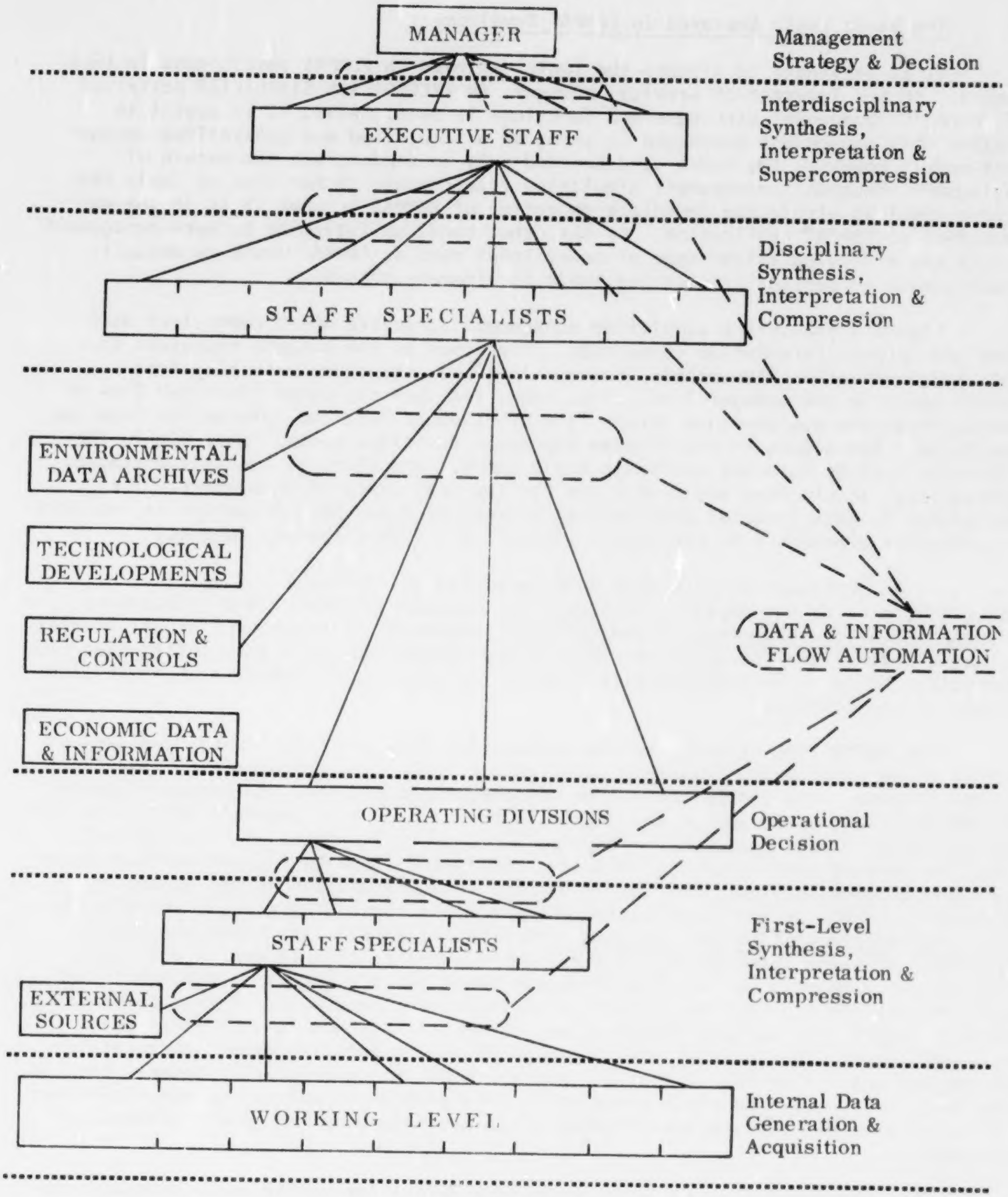
MANAGER
Management Strategy & Decision
EXECUTIVE STAFF
Interdisciplinary Synthesis, Interpretation & Supercompression
STAFF SPECIALISTS
Disciplinary Synthesis, Interpretation & Compression
ENVIRONMENTAL DATA ARCHIVES
TECHNOLOGICAL DEVELOPMENTS
REGULATION & CONTROLS
ECONOMIC DATA & INFORMATION
DATA & INFORMATION FLOW AUTOMATION
OPERATING DIVISIONS
Operational Decision
STAFF SPECIALISTS
First-Level Synthesis, Interpretation & Compression
EXTERNAL SOURCES
WORKING LEVEL
Internal Data Generation & Acquisition

FIGURE 1

MANAGEMENT PROCESS STRUCTURE AND FUNCTIONS formally at all levels below top management -- and the conversion process occurs, at least mentally, at the top management level also; Data and information become progressively less detailed and specialized as they proceed from the bottom level to the top; Staff specialist level synthesis and interpretation is generally aligned with specialized expertise -- i.e., single discipline as to range -- with the degree of specialization varying inversely with the level in the hierarchy; and The key to data/information conversion is the ability to combine specialized (disciplinary) summations into management information -- i.e., perform interdisciplinary interpretation and compression into management display -- which function is concentrated in the hypothetical structure of Figure 1 at the executive staff level.

The last of these functions is the principal bottleneck in realizing effective environment-dependent management today. THIS IS NOT BECAUSE OF AN INHERENT INABILITY OF THE SPECIALISTS INVOLVED, BUT BECAUSE OF (1) THE LACK OF COMPLETE SETS OF VALID DYNAMICALLY CORRELATABLE DATA AND (2) THE UNAVAILABILITY OF A COMPUTERIZED INFORMATION SYSTEM WHICH PERMITS INTERDISCIPLINARY SYNTHESIS, FUNCTIONAL ANALYSIS AND DISPLAY. The second of these essential capabilities permits the English-language-query/quick response-in-rapid-reference-form iterative procedure which develops the required knowledge of functional relationships between operational and environmental variables. WITHOUT THIS KIND OF ASSISTANCE AND COMPLETE SETS OF PERTINENT DATA, THE DEVELOPMENT OF KNOWLEDGE AS TO THE ENVIRONMENTAL DEPENDENCE OF THE MANAGED SYSTEM AND THE QUANTITATIVE DEFINITION OF TRADE-OFFS BETWEEN ECONOMIC, LEGAL, SOCIAL, OPERATIONAL AND ENVIRONMENTAL FACTORS WILL CONTINUE TO BE EXTREMELY SLOW AND INEFFECTIVE.

From the point of view of INFORMATION FLOW AUTOMATION, Figure 1 is indicative only of the functional chain. A single query at the top can easily generate 10 to 100 queries at the executive and specialist staff levels and subsequently generate a need for 10,000 to 10,000,000 items of pertinent data. As these data flow back into response channels, the rate of compression must be almost as great as the rate of expansion in the query channel. For example, consider only the types of management questions most often asked today -- "What is the environmental impact of construction project A?" and "What is the economic impact of proposed environmental quality regulation B?". Such questions, which are of great importance in today's society, generate huge "impact statements" based on even larger collections of data, opinion, publications, etc. -- and even then the statements are largely unsatisfactory because the necessary complete sets of pertinent data are not available and the means to reduce these data to a quantitative definition of economic trade-off for environmental gain or vice versa have not been available.

In further clarification of the SIMULATION function, it is useful to refer to the highly simplified diagram in Figure 2 representing a "concept verification test" (CVT) model for an extractive industry. Figure 2 shows a greatly reduced "basic business cycle" and indicates only representative functional inputs from financial, technological, environmental and regulatory controls. In real applications, such models become highly complicated "spaghetti diagrams" wherein all significant functions of the business cycle are represented and cross-connected as required for complete simulation. Also, the financial, environmental, technological, regulatory, etc. cycles are broken down into numerous components interconnected within themselves and to all of the other cycles, again simulating actual management procedures, external controls, internal options, etc.

Figure 2 is presented only to indicate the nature of the interaction between environmental factors (the shaded portion of the model) and the managed system.

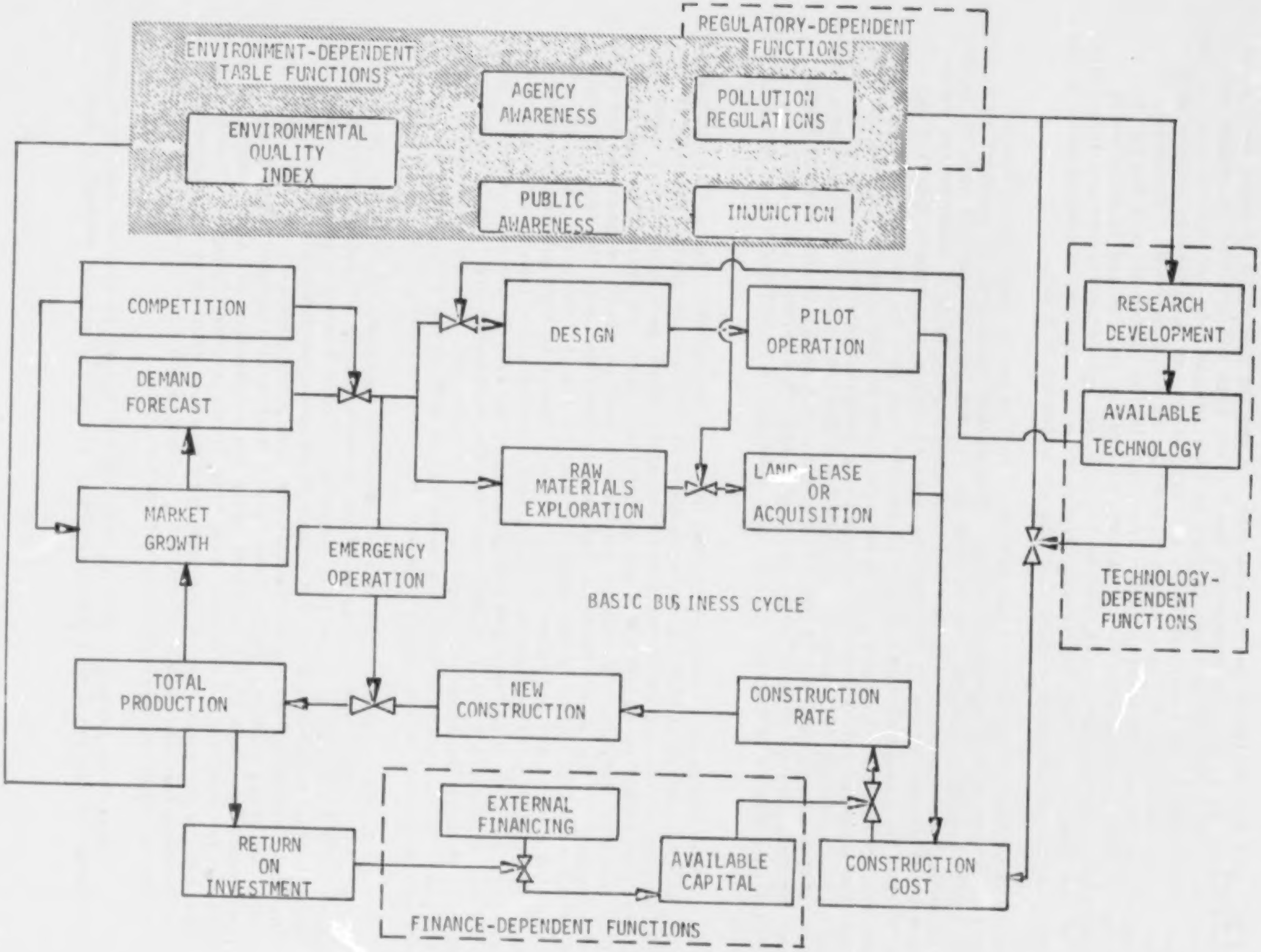
ENVIRONMENT-DEPENDENT TABLE FUNCTIONS
ENVIRONMENTAL QUALITY INDEX
AGENCY AWARENESS
PUBLIC AWARENESS
REGULATORY-DEPENDENT FUNCTIONS
POLLUTION REGULATIONS
INJUNCTION
COMPETITION
DEMAND FORECAST
MARKET GROWTH
EMERGENCY OPERATION
TOTAL PRODUCTION
DESIGN
PILOT OPERATION
RAW MATERIALS EXPLORATION
LAND LEASE OR ACQUISITION
BASIC BUSINESS CYCLE
NEW CONSTRUCTION
CONSTRUCTION RATE
RESEARCH DEVELOPMENT
AVAILABLE TECHNOLOGY
TECHNOLOGY-DEPENDENT FUNCTIONS
RETURN ON INVESTMENT
EXTERNAL FINANCING
AVAILABLE CAPITAL
CONSTRUCTION COST
FINANCE-DEPENDENT FUNCTIONS

FIGURE 2 - MODEL FOR AN EXTRACTIVE INDUSTRY

Specifically, environmental factors adjust the transfer rate and time lag between various basic business cycle components while, conversely, the basic business cycle provides outputs which modify the environment in terms of rate of change and time lag. "Environmental quality index" is, of course, a fictitious quantity which, at this point in time, represents a "summation" of various quality indices generally based on the best available definition of allowable concentration of pollutants, best estimates of average rates of exchange, etc.

One point of emphasis regarding the CVT model is that it demonstrates the importance of the "table" or "control" functions generated through both disciplinary and interdisciplinary synthesis, interpretation and compression of data and information. Such table functions are generated in essentially all organizations, whether their existence as such is formally recognized or not, since they implement the basic business cycle and operate the "valves" which influence rate and time lag which are shown schematically in Figure 2.

In the management process, table functions are generated on the basis of real data which is dynamically correlatable -- i.e., data which permit the valid determination of functional relationships. Verification testing of the adequacy and accuracy of table functions in an actual management system or in a CVT model must be based on such data and must involve its use for management purposes followed by analysis of system or model performance. The combination of (1) a "living atlas" of environmental and environment-dependent social process data and information provided by EDMPAS, (2) accurate table functions for a specific or representative organization, and (3) the availability of a CVT model for that organization advances the development of all phases of automation and simulation of the management process by reducing the time required to observe results of strategy and decision and indicating at least the direction of change resulting from trade-off decisions. Even in embryonic and highly approximate form, CVT models can provide a useful guide to accurate synthesis and compression functions in the information management system. Referring to Figure 2, EDMPAS was designed to handle all data and information relevant to the shaded area and permit the development and testing of the relevant "environment-dependent table functions". It can then provide these as inputs to existing models simulating the basic business cycle and other (technological, financial, etc.) interactions pertinent to management or THESE CAN BE INCORPORATED INTO EDMPAS.

A second point of emphasis is that the CVT modeler usually designs the model to receive a "biological index", a "water quality index" on some other quantity which is assumed to have a known relationship to the rest of the CVT model wherein the relationship has been established with sufficient accuracy for model operation. Unfortunately, neither the "index" nor its influence on the basic business cycle is now known. Those functions and real-data-derived table functions represented in the shaded area of Figure 2 are essentially unknown. Environmental properties and processes are not adequately described by constants (e.g., climatological averages), periodic functions, or other simple mathematical functions. If "verification testing" is to be an integral part of the CVT model, the output from the shaded area of the CVT model in Figure 2 should consist of table functions generated by dynamic models, or their human equivalent, on the basis of near-real-time data plus historical data (e.g., a "living atlas"). Equally apparent is that environmental properties and processes vary from ecosystem to ecosystem; hence the variable drives (table functions) and related "indices" would differ from one area to another (e.g., from Tampa Bay to Galveston Bay).

General information management systems are already commonly used (e.g., by banks and investment houses) to simulate the *unshaded* functions shown schematically in Figure 2. Detailed ten-year business projections are fully automated by these systems based on a few critical market and operating management forecasts. For those operations which are environment-dependent, however, table functions are not established and verification testing is not possible. In such cases, then, the CVT model is a $100,000 model with million dollar gaps in its structure.

### C. *Basic Automation/Simulation System Requirements: General Characteristics*

The structure and functions of an information flow automation and management process simulation system must obviously parallel and be compatible with the structure and functions of the managed system. From paragraphs A and B, it follows that the "query channel" consists of

- A management level -- or *decision* requirement -- query which is directed to
- A categorical *knowledge* level consisting of a combination of disciplinary and interdisciplinary expertise where the sub-queries essential to response are generated for that information not in hand which are directed to
- An *information* level where data has been statistically and/or functionally compressed according to a formalized procedure known to be responsive to management needs and, after analysis of the adequacy of on-hand information, directs requests to
- Internal and external sources for those data needed to complete the set from which an informed response can be generated.

The flow of responses in the opposite direction obviously follows the reverse procedure from *data* to organized and statistically correlated *information* to the *knowledge* level where synthesis, interpretation and final compression functions are performed, thence to the management level where compressed knowledge is converted into strategy and *decision*.

Equally obvious, and equally trite, is the fact that all information and knowledge is *not* generated in response to specific management query. Data are generated for many reasons; these are collated and organized into various forms of information as a result of curiosity, or a search for better understanding; knowledge is generated when expertise is directed to the interpretation of such information as a result of general interest or continuing responsibility; and, when apprised of such knowledge, decision and new strategies are *then* formulated.

Automation and simulation of environment-dependent systems must, then, take into account both top-down and bottom-up strategy and decision-making. To stipulate such an apparent requirement risks the accusation of naivete. However, it is a definite basic requirement and does influence information management system design. Further, numerous examples exist where

- The top-down designed system results in the acquisition of useless or less-than-effective data and unnecessarily cumbersome and expensive formatting, processing, etc. on the part of the data taker and information system personnel; or conversely,

.. The bottom-up designed system all too often provides an abundance of data and statistics which are frequently irrelevant or constitute more data than can be effectively used by management -- with attendant increases in the cost of storage, retrieval and processing.

The need to close the feedback loop in such a way that these generally opposing viewpoints are effectively merged is an obvious goal. As stated in paragraphs A and B, the approach taken in EDMPAS development was that of starting in the middle and working in both directions -- i.e., developing the system by disciplinary and interdisciplinary specialists who were also engaged in the active acquisition of "live" data, its correlation and analysis in combination with archived data, and interpretation of the composite for the formulation of a recommended strategy or decision. While admittedly "loaded" on the environmental side in terms of development team expertise, considerations such as those described in paragraphs A and B were actively incorporated by the GURC development team.

Good information management system design, therefore, must consider an integrated set of modular software packages whereby the four "levels" of data, information, knowledge and decision in the management system are automated and simulated to that degree which is technically feasible and also consistent with management requirements. Figure 3 is a schematic presentation of the interrelation between the management "information triangle" and its equivalent supportive automation/simulation component, Figure 3 is exceedingly simplified. Nonetheless, it categorizes the types of automation and simulation functions required in proceeding either way in the management feedback loop. Also, it is descriptive of the characteristics of generalized functions of the system of integrated software packages required for automation and simulation.

The triangular shape and progressively smaller area of its segments from bottom to top infer, of course, the progressive conversion from massive quantities of data to highly compressed information. Solid query/response connectors indicate the general situation as it exists in environment-dependent systems - emphasizing, particularly, the necessity for automation at Levels I and II and the optional nature of simulation and further compression via dynamic correlations and modeling beyond that point.

Recognizing both the optional nature of dynamic and CVT models and the questionable value of general models (i.e., models not developed for a specific organization or type of management problem), EDMPAS development has thus far emphasized software to implement Levels I and II. HOWEVER, the effort has included the development of representative dynamic models of environmental processes and close liaison with the development of CVT models such that their integration into EDMPAS is quite feasible and direct.

Hardware/software incompatability poses technical difficulties to such a general concept. However, the recent breakthroughs in computer technology difficulties such as multi-programming, teleprocessing, teledisplay, mini-computers, distributed intelligence, low cost memories, etc. have set the stage for modular

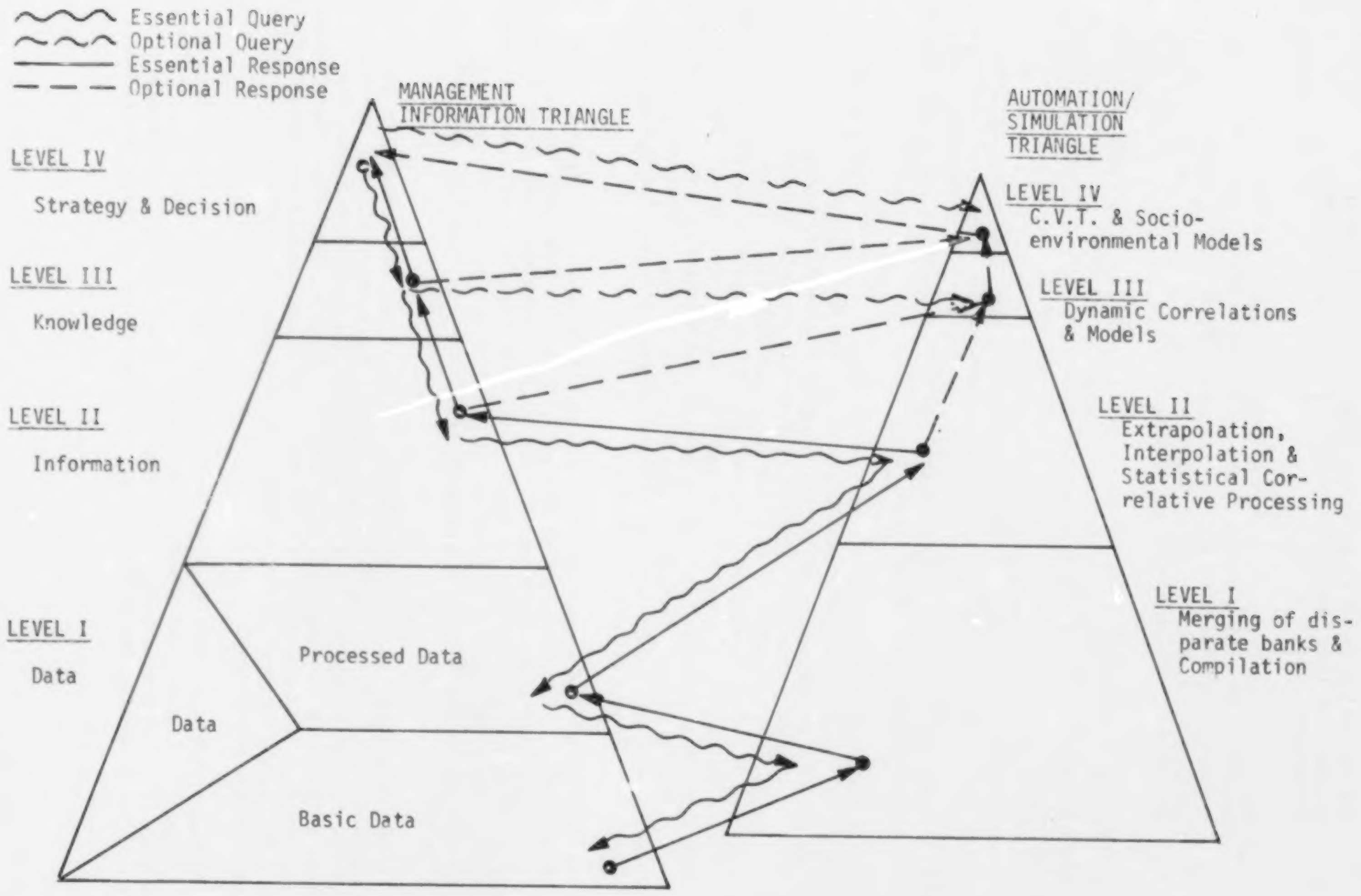
Essential Query
Optional Query
Essential Response
Optional Response
MANAGEMENT INFORMATION TRIANGLE
LEVEL IV
Strategy & Decision
LEVEL III
Knowledge
LEVEL II
Information
LEVEL I
Data
Data
Processed Data
Basic Data
AUTOMATION/ SIMULATION TRIANGLE
LEVEL IV
C.V.T. & Socio-environmental Models
LEVEL III
Dynamic Correlations & Models
LEVEL II
Extrapolation, Interpolation & Statistical Correlative Processing
LEVEL I
Merging of disparate banks & Compilation

FIGURE 3 - AUTOMATION AND SIMULATION AS THEY RELATE TO THE MANAGEMENT "INFORMATION TRIANGLE"

software systems for environmental management to be visualized as a feasible concept rather than technological imagination.

## SUMMARY

The EDMPAS environmental information management system is a set of intercompatible software modules selectively integrated by its executive command module, ENVIR. It was developed to permit flexible and efficient management of environmental data and information and to interface with (but not replace) existing archives or banks of data, with dynamic models of environmental and social processes, and with organizational structures and functions (whether computerized or not). Among its established capabilities are:

Handles descriptive botanical, zoological economic, etc. (word type) data in the same alphanumeric system with physical, chemical, geological and other "hard science" data;

Merges such data from disparate archives, banks, or active data acquisition programs to compile a temporary project information file -- and then restores data to the archives automatically via tape transfer or telemetry;

Provides unlimited flexibility as to number and arrangement of descriptors and items, and corrections or additions thereto, without system changes;

Extrapolates real data to any desired number and distribution of synthetic data points (in continuous oceanic and atmospheric processes) as necessary for complete display of dynamic fields as time-series-on-a-map;

Accepts English language interdisciplinary query and responds with graphic or compressed hard copy answers without intermediate handling or manual transfer;

By using calculated storage and retrieval, a complete Boolean capability, and complete inversion of all files, accomplishes these functions at computer speed as a result of direct access to any bit in storage and with descriptor and item subset selectability as prescribed by query; and

Since the compression of data increases geometrically with the number of bits in the file, it accomplishes these functions with not more than 32K of memory for essentially infinite bit accessibility (and even less memory for useful standalone modules within the system) such that utility is not limited to large computers.

These capabilities have been tested using real data from real environmental systems. However, it is in its research applications mode in terms of its state of preparedness for application at this time. Complete integration of the system is not scheduled for completion until approximately mid-1973.

At its fifteen-month stage of development, EDMPAS does not accomplish all of the automation and simulation functions that environmental specialists and their management counterparts might like to have. However, even at this stage, it appears to provide exceptional capability for accession, correlation, compression and display of interdisciplinary environmental information and for the merging and interfacing with archives, dynamic models and existing information systems designed for business or operations management.

# PREFACE TO INTERGOVERNMENTAL RELATIONS IN MANAGING THE ENVIRONMENT

All levels of government--federal, state, regional, and local--interact in virtually every sector of the socio-economic system. Environmental management plays a vital part in this complex interaction. As discussed in the five articles in this section, intergovernmental cooperation is essential in meeting the demands of improving the environment.

The local perspective is presented by Thomas West in his article entitled "The Growth and Development of Environmental Control in Erie County." West traces the awakening of environmental awareness to critical problems of Lake Erie. A large citizen environmental planning effort resulted in the consolidation of the City and County Health Departments into a single agency responsible for environmental management. The remainder of the article deals with Erie County's attempt to receive authority for administering all environmental control programs currently under the Pennsylvania Department of Environmental Resources.

Regional solutions for multijurisdictional problems is the focus in "Managing the Environment: Who's in Charge," by William Pitstick. Pitstick outlines the environmental management setting--air quality, solid waste, noise, open space, water quality--in North Central Texas and the role of the North Central Texas Council of Governments in particular. After discussing the organizational options for planning and managing evironmental programs, the "holding company or regional service authority" concept is suggested as a feasible alternative for implementing environmental planning and management.

Wesley E. Gilbertson in his article "States in the Federal System: The Case of Water Pollution," argues that the federal government's assistance (e.g., technical consultation, grants, research) should be utilized only when states are not already operating functional programs.

Finally, David Walker in "Triumphant Technocrats and Nonfunctioning Federalism," cites the increasing number of specialists entering into the federal system directly as a result of the categorical grant programs. Even with revenue sharing on the scene, he feels that stronger state and local leadership and management may not necessarily emerge under the present state of "functionalism".

# THE GROWTH AND DEVELOPMENT OF ENVIRONMENTAL CONTROL IN ERIE COUNTY

Thomas C. West*

## HISTORY OF ENVIRONMENTAL MANAGEMENT IN ERIE COUNTY

In recent years there has been a growing criticism from the public that government is not responsive to their needs. This criticism has been very pronounced in the area of environmental control. The administration of the environmental control programs in Pennsylvania, as well as most other areas of the country, is predominately at the State – Federal level so that local citizens and the local governmental units have virtually no input into the implementation of the control programs.

The situation in Erie County was no different. The County environmental control programs relative to: Industrial Waste, Public Water Supplies, Public Sewage Facilities, Public Bathing Places, Occupational Health, Solid Waste and Air Pollution Control was administered from a State regional office outside the County. The State office also covered thirteen other counties and, consequently, the resources --manpower and time--were often not available when they were required locally.

In the early 1960's the dissatisfaction with the system to implement environmental control programs began to grow locally. Various conservation groups, women's organizations, and sportsmen organizations among others, became more active in attempting to strengthen environmental control programs. A strong impetus was provided in the early 1960's when the problems of Lake Erie received national attention. Since Lake Erie plays a vital part in determining the economic development of the County as well as contributing to the physical well-being of the citizens, Lake Erie pollution, therefore, aroused the general public in the County and served as a central issue to gain support for taking more positive action to protect the environment.

The Erie County sportsmen organization soon became the largest organized group and the most active in spearheading an action program. The organization was not satisfied with the ability of the State to respond to local problems; nor were they satisfied with the environmental control legislation. By the mid-1960's the organization had a local membership of nearly 25,000 members (out of a County population of approximately 250,000 at the time and with a total State membership of about 250,000). The sportsmen began to support candidates locally and statewide who were conservationists. In Erie County their support was instrumental in the election of County Commissioners sympathetic to a strong environmental control program.

The Erie County Department of Health believed that it was the logical agency to assume a more active role in the administration of environmental control programs. However, the Erie County Health Department, along with the other four county health departments in Pennsylvania (only five out of sixty-seven counties have county health units), had never been given the authority to administer all environmental control programs. Although the enabling State legislation, passed in 1951, permitted the

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His article was prepared for this volume.

decentralization of State programs to the county health units, the State had retained the authority for the major environmental control programs.

Erie County was selected by the Pennsylvania Department of Health and the United States Public Health Service as the first area to conduct a demonstration on Urban Planning for Environmental Health. This was one of the first organized efforts in Erie County to encourage citizen in-put into environmental planning. An advisory committee composed of representatives from a college, the U.S.Public Health Service, Pennsylvania Department of Health, Erie County Department of Health, City and County Planning Department, local government, medical association, a planning consultant and lay citizens provided the guidance. The committee initiated an Environmental Health Survey (entitled ERIELAND-2000) in 1965 as the foundation for expanding local environmental control programs.

The survey made numerous recommendations in the following areas: Water, Liquid Wastes, Solid Waste, Air Pollution, Housing, Recreation, General Health and Planning. Implementation of many of the recommendations began almost at once (by 1972 approximately 80% of the environmental recommendations that were a direct responsibility of the Health Department had been implemented). One of the most important recommendations was implemented in January of 1969 when the Erie City Health Department combined with the County Health Department. With the centralization of local environmental control agencies into one unit, the County began to encourage more cooperative efforts with the State in water pollution control The State expressed a reluctance in the beginning to relinquish any part of their programs but, after a number of years, the advantages of mutually cooperative programs became more evident.

Beginning in 1970, discussions were held more frequently between the County and the State relative to decentralizing the authority to administer all environmental control programs to the County. At about this time, the Ford Foundation first contacted the County relative to funding an environmental program. The County Health Department then prepared a proposal to the Ford Foundation to fund a project whose primary purposes would be to assist Erie County in a program that would enable the Erie County Department of Health to assume the environmental control programs administered by the Pennsylvania Department of Environmental Resources and to develop local resources to address environmental problems. The Ford Grant Project intends to develop a model County Department of the Environment by encouraging the decentralization of environmental control programs to county health department for the first time. If successful, the Project could serve as a model for other county health departments.

## ENVIRONMENTAL PROGRAM ACCOMPLISHMENTS

During the period for developing the Project with the Ford Foundation, the County had received tentative agreements from the State to enter into the experiment, provided the County had properly trained staff and adequate equipment to carry on the programs. The Ford Grant assured the necessary funds to provide both staff and equipment. One of the first steps, then, was to reorganize the Department of Health into a Bureau of Personal Health Services and a Brueau of Environmental Health. The newly-created Bureau of Environmental Health consists of the former Division of Sanitation and Rodent Control and three new divisions: Occupational Health, Sanitary Engineering and Enforcement.

Late in August of 1971, the Ford Foundation program began officially with the hiring of the Division Directors for Engineering and Occupational Health. A key Sanitary Engineer from the Pennsylvania Department of Environmental Resources was employed to head a County engineering program. Similarly, the Supervisor of the

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State Occupational Health program for a fourteen-county area was hired as a Division Director.

The first task facing the Division Directors involved completion of the formal agreements between the Erie County Department of Health and the Pennsylvania Department of Environmental Resources to decentralize the engineering and occupational health programs. The Division Directors were given almost complete freedom in preparing the agreements.

## Division of Engineering

Under the new Division of Engineering, an agreement was prepared by the County and signed by both the State and County representatives to decentralize authority to the County in five phases. For the first time the State has agreed to decentralize all of the following programs to a County Health Department: Industrial Waste, Public Water Supplies, Public Sewage Facilities, Public Bathing Places and Solid Waste.

At this time the Division is nearly ready to assume the fifth and final phase of the agreement. The water pollution control program of the County with the backup resources of the State will be the most effective and comprehensive of any area in the State.

## Division of Occupational Health

The progress on decentralizing the Occupational Health program has proceeded smoothly. The agreement with the State is much broader in relationship to that of the Division of Engineering. The agreement permits the Division Director to decentralize the program at his discretion, provided the County has the staff, equipment and resources. The Division merely submits a list of the Standard Industrial Classifications (a coding identifying particular types of industries) of the facilities that the County will assume. The State then formally decentralizes the authority for these particular portions of the program. The rate of take-over is, therefore, wholly dependent upon the Division Director and his staff.

The program is responsible for evaluating the environmental conditions under which an employee works in every industry and business in the County. The program has been very successful. Priority programs have already been established for numerous industries that will require the expenditure of millions of dollars by local industry to correct violations of the regulations. Under the State program, three Occupational Health specialists had to cover fourteen counties including Erie County. Since the County program has the same number of personnel, response to complaints and follow-ups to routine inspections are immediate.

## Division of Enforcement

In January 1972, an attorney, who was a former District Attorney, was retained to head the Division of Enforcement and accepted the responsibility for all the legal actions initiated by the Health Department. Provisions were made under the Grant Project to appoint the attorney as a Special Assistant State Attorney General to enable him to handle the State's environmental cases in Erie County. He has already represented the Department in a number of legal cases. The addition of the Division of Legal Enforcement has greatly strengthened our various programs. Since the addition of a lawyer to the staff in January 1972, there have been 362 enforcement cases. There were: 313 Letters and orders issued, 11 Administrative hearings, 1 Water Quality Board hearing, 28 Summary Actions, and 9 court cases.

## Air Pollution

Under the proposed Ford Foundation Grant, the County had planned to decentralize the State air pollution program. It became apparent during the negotiations with the State that it would be most difficult to achieve this objective the first year. It would have been possible for the County partially to assume the program. However, all policy and enforcement decisions would have remained with the State. County officials believed that the agreement would have created numerous problems and expenditure of a great deal of manpower resources by the County without achieving a more effective program. The decision was made to postpone this program and establish the other divisions first.

Changes in air pollution legislation during 1972 removed some of the original obstacles, and negotiations are again underway to try to decentralize this program in 1973.

## Developing Local Resources

Under the Ford Foundation Grant proposal, several special projects were also included. One of these projects will be discussed to illustrate how the Grant is encouraging the development of local resources. Although much had been written about the general condition of Lake Erie and, in particular, the western portion of the Lake, no detailed studies had ever been conducted in the Pennsylvania portion. The Department believed it essential to have more information about the lake so that parameters would be available to measure change. Under the Ford Foundation Grant, a Lake study was initiated and contracted to the Great Lakes Research Institute, a local non-profit organization that had primarily been established as a vehicle to pool local resources to address problems that would improve the quality of living in Northwestern Pennsylvania. The Institute in turn subcontracted for the services with local institutions: The Biology Department of two local colleges and the Chemistry Department of two other area colleges; the Analytical Chemistry Laboratory and the Scientific and Engineering Computer Center of Lord Corporation. The State Regional Water Pollution Laboratory located in Erie and the local office of the Pennsylvania Fish Commission also participated.

In another attempt to develop local resources, a Citizens Environmental Advisory Committee was recently formed to establish close communications with the public. The purpose of the Committee will be to become familiar with the present County environmental control programs. The Committee is composed of a cross-section of the community, representing industry, agriculture, labor, Soil Conservation Service, Pennsylvania Fish Commission, conservationists, women's organizations, colleges, high schools, sportsmen organizations, county, township and borough governments, and the City of Erie.

## THE FUTURE OF THE PROGRAM

The future for the Erie County Ford Grant project to create a County Model Department of the Environment looks excellent. The project has already made significant strides in decentralizing the State programs to the County Health Department. The actual formation of a Model Department of the Environment is within reach since the three important factors necessary for its success have been developed. The

Public, County and State support required for the success of such a program has been established. Local citizens have demonstrated the need for stronger local environmental controls; the County Commissioners have supported the environmental objectives of the project (a previous Democratic and Republican administration and the present Democratic administration); the Pennsylvania Department of Environmental Resources has offered total support for the project. Legislation is presently being drafted that would permit and fund County Departments of the Environment and provide for a mechanism for greater cooperation between the State and County.

The cooperative program with the State has (1) permitted the decentralization of authority to the County, (2) offered the services of the highly-trained and specialized State staff for a back-up resource, and (3) offered the use of the State Water Pollution Laboratory in Erie and the Occupational Health Laboratory in Harrisburg. As a result, the project is the most comprehensive environmental control program of any county in Pennsylvania.

The only real source of problems to the Project have inadvertantly arisen from the implementation of recent Federal legislation attempting to strengthen environmental control programs nationally. In the Federal-State negotiations where the Federal Government is delegating program responsibilities to the States, problems occur that may seriously affect State-Local program relationships. County government -- that is the various county departments and agencies -- must take a more active interest in the development of new programs between the Federal and State government so that local interests are not compromised.

In conclusion, the Erie County Ford Grant project to create a Model Department of the Environment by decentralizing State programs to the County has demonstrated what may be accomplished through inter-governmental cooperation. In Pennsylvania, responsibilities for environmental control have been delegated to a County Health Department for the first time. The project has provided an example where through cooperation two governmental units can provide a more comprehensive environmental control program without duplication of efforts on the local or regional level than would have been possible by the State, County or Federal governments acting independently. The program has suggested that the answers to providing comprehensive environmental control programs, should provide adequate provisions to permit local participation.

# MANAGING THE ENVIRONMENT: WHO'S IN CHARGE?

William J. Pitstick*

In the early part of this century we had the beginning of the reform of local government, which included the birth of council-manager government. In subsequent decades we had two wars and a depression. In the sixties we had the "people" revolution, with attention focused on the problems and issues of poverty, peace, youth and race. The agenda for the seventies reflects recognition and response to a variety of issues. We see the emergence of a workable federal system--the reshaping of government in metropolitan areas, and attention to the substantive urban problems--one of which is managing the environment--in order to improve the quality of life.

This paper will attempt to outline initial efforts by the North Central Texas Council of Governments to plan for the management of the environment in the Greater Dallas-Fort Worth Metropolitan Region, including the various options for implementation that are under consideration.

## Regional Solutions for Regional Problems

Though the conflicts between suburb and central city or between county and municipality are strong and bitter in some areas, even these obvious differences can not prevent the realization that air and water pollution, solid waste disposal, rising crime, substandard housing, traffic congestion, social unrest, and a host of other urban ills do not respect or recognize the boundaries erected by pen strokes on a map.

The failure of many local programs in recent years may very well have been due to the unilateral approach, to the delusion that any one community can rise above the problems and conditions that surround it. A regional approach to regional problems, on the other hand, provides an excellent opportunity to apply comprehensive and intensive area-wide planning and implementation towards the solution of these problems.

After several decades of largely unsuccessful attempts to create a mechanism to respond to metropolitan problems, we see emerging an evolutionary concept (the concept of regional councils of public officials, or metropolitan councils of government) in an attempt to civilize the jungle of local government. Less than five years ago, the number of regional councils could be counted on two hands. Now there are so many councils in existence or in the process of establishment, that no one could name them all. There are 24 in Texas alone.

The furnishing of services and facilities to citizens should be evaluated in terms of the level of government most logical to perform each service. Some should be furnished at the neighborhood level, some city-wide, and some at the state or national level. Environmental problems are among those that need to be attacked at the area-wide or regional level.

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## The Environmental Management Setting In North Central Texas

NCTCOG's interest and dedication to environmental quality throughout the North Central region is reflected in several of its major programs and activities. These include work already completed, in process, and anticipated as follows:

Air Quality. "Clean Air for North Central Texas," a report from the NCTCOG Citizen's Committee for the study of air pollution, made 19 recommendations concerning air resource management, including development of an "environmental protection system" which would include a "Comprehensive Waste Management Strategy" dealing with air, water, and solid wastes. The "Model Clean Air Ordinance for the North Central Texas Region" as prepared by NCTCOG, has been adopted by a majority of cities in the region. In implementing the Clean Air Act the National Air Pollution Control Administration, formerly of Health, Education and Welfare, had previously designated the ten counties of North Central Texas as an air quality control region. It will be the responsibility of the Texas Air Control Board to designate an air quality control agency for planning, monitoring, controlling, and enforcing the federal, state and local air quality standards. It is quite possible that the North Central Texas Council of Governments may be assigned some responsibility in connection with this proposed operating regulatory agency.

Solid Waste Management. The North Central Texas Council of Governments has underway a systems analysis study and Regional Plan for Solid Waste Disposal in North Central Texas.

The study will have for its output the following objectives:

a. To develop for implementation an incremental regional plan for the disposal of solid waste from the present to a target year of 1990. Such a plan will designate the optimum system which will provide for an equitable cost distribution among the municipalities and governmental entities within the study area.

b. To provide interim solutions to existing transfer and disposal problems for those governmental entities within the study area which are currently at a decision point regarding existing facilities.

c. To provide a continuing system of evaluation to react to the dynamics of urban growth and the contingencies which will arise. The implementation plan for this system has not yet been determined. It may be through interlocal cooperation or through the creation of a new regional service authority.

Noise Pollution. Under the Regional Airport Environs Study, the Regional Airport Sound Exposure Map was prepared in cooperation with the FAA and the Dallas/Fort Worth Regional Airport Board in the spring of 1969 -- updated in 1972. In a series of seminars, public officials from cities and school districts to be affected by airport operations, were given training in the use of the map and in other measures designed to minimize adverse affects of aircraft noise and to assure compatible land development in the vicinity of the airport.

Compatible development regulations (zoning ordinance amendments) and building code sound proofing amendments are being prepared for use by all affected cities around the new airport.

Open Space Planning. In recreation and open space, our needs are growing faster than our ability to fill them. Land is being built up at such a pace in our rapidly growing areas, virtually only remnants -- what no one else wants -- are left for parks and recreation, and for natural or ecological area, such a s wildlife preserves. We fail to preserve enough of our historic and scenic areas, a priceless, irreplaceable heritage. And we are not getting large areas of these types close in to our urban areas, but have to travel miles to get to them. We must change State policies to enable local government and regional agencies to plan, acquire, develop, maintain, and operate these facilities together with the State; permit cooperative activity among local units, and authorize regional park and open space systems.

An "environmental corridor analysis" was completed in cooperation with the Texas Parks and Wildlife Department. This analysis indicates natural features and areas which should be preserved and/or protected in order to maintain environmental quality in North Central Texas. NCTCOG's Open Space Plan has been prepared -- and adopted. It will be used as a planning guideline for the future development of parks and recreational facilities in North Central Texas.

Water Quality. In July, 1968, NCTCOG was designated as the agency responsible for preparation of a "coordinated plan and implementation program for water pollution control and abatement" throughout the Upper Trinity River Basin by the Governor, the Texas Water Quality Board, and the Federal Water Pollution Control Administration -- now the Environmental Protection Agency. The program is designed to produce an areawide comprehensive plan and program, both physical and organizational, for trunk sewers and wastewater treatment facilities to serve the entire North Central Texas region -- 12,000 square miles -- 2.5 million people -- an area greater than that of nine states -- and a population greater than that of twenty-three states.

Adoption of the recommended regional sewerage plan will mean the consolidation of fifty-three existing treatment plants into six proposed sub-regional plants. Results of greater consolidation of facilities will be greater quality control on plant effluents, lower overall operation and maintenance, and somewhat lower though comparable capital costs. It is proposed that this plan be implemented through inter-local cooperation. The six sub-regional systems and their respective plants will be operated by four major governmental entities -- the City of Dallas, the City of Fort Worth, the North Texas Municipal Water District, and the Trinity River Authority. Long-range implementation will be directed by a Regional Water Quality Council.

Land Resource Management. Most regional and local policy makers readily accept the need for management of our air and water resources and our solid waste -- and they see these as matters of areawide concern which are not merely amenable to regionalism, but which require an areawide approach for their proper management. They are not so ready to view land resource management in this way. They still look upon it, and perhaps to some extent properly so, as a matter of largely, if not exclusively, local prerogative. And yet the land market is not confined to any given political jurisdiction; it too crosses or transcends political boundaries. So, simply what I am saying, is that we need a better understand of the meaning of land as a resource so that we can develop effective means for managing land resources.

Traditionally, regulation of the use of nonfederal lands has been reserved to the states as part of their police power. Generally, however, the states have not sought to regulate land use, but have delegated authority to do so to local government. The limits of local jurisdiction often have been too narrow to encompass regional environmental systems or to encourage desirable patterns of regional economic development. Local zoning, the main instrument of land use control, typically has been used only to separate incompatible land uses in urban areas. Control over land use in nonurban areas has been minimal.

## Options for Implementation

In exploring various options for implementing the regional sewerage plan, possible organizational alternatives for consideration included the following: (1) a new single-purpose (regional water quality) special district with jurisdictional responsibility for areawide operation; (2) a multi-purpose single agency (e.g., a Master Regional Environmental Quality Authority) to administer related programs of solid waste disposal, water and air pollution, land use regulation, etc.; (3) a single existing agency contractually serving all voluntary participants in a regional sewerage and water quality management system; (4) a single agency (existing or new) with responsibilities only in those operational functions for joint facilities; (5) joint ownership and areawide operations with a multi-purpose agency to plan and coordinate activites for the entire geographic area, and with operational control in areas where no other jurisdiction is feasible; (6) joint operations by largest existing operational agencies (Fort Worth, Dallas, Trinity River Authority, and the North Texas Municipal Water District) contractually serving all other participants; (7) several other multi-agency options, assigning functional responsibility for one or more functions such as financing, regulatory activities, or operations, to an areawide agency.

The practical and politically feasible options in North Central Texas for implementation of environmental planning and management include the following: (1) The Special District or Authority. Special districts, overlapping, and often unrelated to the boundaries of general local governments, are often unresponsive to control by the general public. The bill they present to the taxpayers is too often concealed in special fees or taxes unrelated to the taxes of other local units. The citizen finds it difficult to keep track and to register his preference and dissatisfaction at the voting booth. Although there are a few large responsive and responsible special districts existing in North Central Texas--this method of implementation in the future will very likely not be recommended.
(2) Regional Government. A new layer of government is not acceptable in North Central Texas. An acceptable regional concept for implementation lies somewhere between inter-local contracting and the regional service authority.
(3) Inter-Local. This provides the most politically acceptable system for implementation at the present time. It can be handled on a sub-regional or region-wide basis with efficiency. It is particularly adaptable for water quality management and solid waste management on a regional basis.
(4) The Holding Company or Regional Service Authority. This concept proposes a multi-purpose single agency (e.g., Master Regional Environmental Quality Authority) to administer related programs of solid waste management, water quality management, air quality control, land use management, and related functions--a metropolitan district with the Council of Governments functioning as a holding company with authority and responsibility for the following: policy control over planning and development, appointment of operating board, and budgetary review.

## Summary

In summary we must recognize the vital need for a shared role between local, State and Federal governments, in finding and implementing solutions to our many urban problems--including air quality control--water quality planning, and solid waste management. It is well recognized that local governments have the problems--the State government has the authority to solve the problems--and the Federal government has the resources to solve these problems. Therefore, it must be recognized by all parties that the answer to our urban needs lies in a cooperative partnership among capable units and agencies of local, State,and Federal governments.

It is obvious that institutions of government will have to be altered to accomodate new demands and new circumstances. The realization of these objectives will depend upon the interest and dedication of the American people and their elected representatives at all levels of government.

As we explore this problem--we need to reconcile the two extremes represented by economic development "at any cost" on the one hand, and by "environmental extremists" on the other. We need to somehow bring these two interests together on some middle ground that will allow us to make reasonable and realistic advances, both economically and environmentally.

# STATES IN THE FEDERAL SYSTEM: THE CASE OF WATER POLLUTION

Wesley E. Gilbertson*

Environmental protection, management, and enhancement represent unusual challenges to political leaders of our time. The environmental consciousness of the people of this nation has been awakened. The predictions of environmentalists are coming true and people are realizing that we must do a better job of environmental management or suffer the consequences.

In Pennsylvania we have found that it is not possible to separate the problems and solutions of water, air and land pollution. This fact was recognized earlier this year when all of the State's environmental resources programs, including environmental protection programs, were integrated into a newly created Department of Environmental Resources.

One of the principle areas of environmental concern by citizens and the State of Pennsylvania is water pollution. Because of earlier serious water pollution problems, the State has a rich history of water pollution control. The first comprehensive water pollution control legislation was enacted in 1936, and was strengthened in 1945, in 1965, and in 1970, until we now have one of the broadest and strongest water pollution control laws in the nation. It has expanded our program authority beyond the usual waste discharges to allow the prevention of pollution from any "activity." But laws alone are not enough; they must be implemented effectively. Effective implementation requires a dynamic multifaceted program.

Pennsylvania's implementation program establishes water quality standards for all waters of the state. The job is about half done for surface waters and now starting on ground waters. The state is one of few that utilize predictive mathematical models in the development of water quality implementation plans to insure that water quality criteria are met after waste treatment facilities are constructed or upgraded. An "Environmental Strike Force" of attorneys has significantly stepped up the enforcement program. In the past year 59 injunctions have been filed and 10 more are expected to be filed soon. About 87 percent of the cases are in compliance or making satisfactory progress. One hundred eighty-four miles of Pennsylvania streams showed significant water quality improvement during 1970. Funds from a $500 million bond issue are utilized to supplement federal construction grant funds. An additional 2 percent of sewage treatment plant construction costs is paid to municipalities to support their operation and maintenance effort in municipal waste pollution abatement.

Many other states are as concerned about the environment and have also strengthened their water pollution control legislation and created new organizational structures to do a better job of protecting, enhancing, and managing the environment.

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Excerpted from a statement On Water Pollution Control Legislation delivered before the House Committee on Public Works, August 4, 1971

## A National Water Pollution Control Program

Because of the complexities of the problem and our experiences with the program to date, we are convinced that a national program, not a centralized federal program, is the most effective and efficient way to get the job done. In a national program, the federal government should establish the goals for the program and monitor progress toward those goals. The federal government should assist the states with grants, technical consultation, research and training. Most states are already set up to carry out the everyday regulatory work that includes setting of standards, operating permit systems to control waste discharges and inspecting and monitoring individual case compliance with pollution control laws. Where states are not set up to do this, the federal government should help the state develop such a program and if the effort fails, step in.

## Difficulties With the Current Federal Water Pollution Control Program

I am concerned that the current federal strategy to solve water pollution problems is likely to miss its intended goal. First we find a significant trend toward duplication of state activities by the federal program. The potential for this duplication exists in the permit system area. A permit system which duplicates many state programs has been implemented under the 1899 Refuse Act. Two permit systems are no better than one good one. Federal legislation should restore a single permit system - a state system and allow the federal government to step in where a state system is not adequate.

Secondly, there is a trend toward greater demands for federal program support from state programs. States are now receiving federal requests for information in such detail that filling these requests actually inhibits the states from carrying out their water pollution control efforts. The impact of federal requirements for state project reviews under Section 21(b) of the Federal Water Pollution Control Act, the National Environmental Policy Act, the 1899 Refuse Act and Federal Budget Bureau Circular A-95 has been overwhelming. The workload of review of such projects has jumped from 1,500 in fiscal 1970 to 6,000 in 1971. Inadequate federal recognition has so far been given to the program impact of such federal requirements. I can assure you that the result so far has been that we look at a lot more paper and clean up a lot less pollution.

Another important element in building more effective state programs involves providing adequate financial support. Grant programs should include broad goals and minimize detailed standards for state programs. The goals should insure that the job is being done but inordinate amounts of state program time should not be required to supply detailed data to the federal agency. Rather than require additional "hoops to jump through" to obtain a program grant, more constructive management-type evaluation methods are available in lieu of the current base-by-case evaluations.

Funds for program grants are not adequate to give the States the support they need to carry out their responsibilities in a national program. Thirty-six percent of the federal money being spent for water pollution control is spent for the federal program and research. Sixty-two percent of the funds go to municipalities for construction of sewage treatment facilities and only about two percent goes to state water pollution agencies to aid in enforcing water pollution control laws.

Compared to the air pollution control program, the states are being shortchanged in their water pollution control effort. Last year for each dollar of

Pennsylvania money spent on its air pollution control program, more than a dollar of federal program grant funds were provided ($1,000,000 in program grants versus over $8000,000 in state appropriations). On the other hand, for th e operation of the water pollution control program, five state dollars were spent for each federal program grant dollar received ($495,000 in program grants versus $2,595,000 in state funds). We believe that the State enforcement and program expenditures should be matched dollar for dollar by the federal program grants.

We have found that the construction grants program has speeded up sewage treatment plant construction. The grant formula providing a 75% federal and 25% non-federal contribution for sewage treatment plant construction should give municipalities no excuse for not building adequate treatment facilities

The proliferation of agencies involved in the funding of water pollution control facilities creates problems for local and state governments in coordinating water pollution control consideration of HUD and Farmers Home Administration administer grant programs for sewers and sewage treatment construction into EPA would prevent duplication and municipal grant "shopping" to see where the best deal is available. Expenditures of grant funds could be better coordinated through a single agency and this should lead to more efficient use of the funds. The establishment of an Environmental Financing Authority also will be of benefit in financing of municipal pollution control facilities.

Special consideration should be given in the construction grants provisions of the act and in the proposed programs of the Environmental Financing Authority for small municipal projects that have prohibitively high individual costs to homeowners. Since sewer systems costs are the significant factor in the high individual costs, grant funds should be made available for sewer systems to bring the costs a householder must pay to a reasonable level. The provisions of the Environmental Financing Authority Act should also cover sewer system and solid waste facilities funding.

A fourth point regarding program strategy relates to the decision to require comprehensive waste management planning in order to save federal construction dollars by reducing uneconomic fragmentation of wastewater systems.

Planning consists of many elements in a water pollution control program. It involves the establishment of water quality standards, the determination of waste collection and treatment system needs, the recognition and provision for the interrelationships of other environmental factors and the development and implementation of new institutional arrangements to carry out the plans. It is estimated that it will cost Pennsylvania between 10 and 20 million dollars within the next four years to develop these plans. We concur with the need for better planning, but the federal requirement should be accompanied by appropriate financial aid. At present, there are inadequate funds available to do the type and amount of planning that is being required by the Environmental Protection Agency. Yet, the planning must be done immediately through a high impact program that will have reduced future financial requirements for plan maintenance. Without planning, there is chaos and money is wasted. The investment in planning can save many construction grant dollars and chart the course for a more effective program of waste and water quality management. This will also greatly minimize the annual quandry of how much construction money we need, by providing much more reliable cost estimates.

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Our experience has been that some minimum treatment or effluent requirements are desirable but that to meet water quality criteria it is necessary to consider watersheds as a whole and by mathematical modeling determine how much treatment must be provided to protect water quality and leave room for future growth. In most cases, in our State, the required treatment levels are higher than secondary treatment. National uniform effluent standards might well present a false picture of what is needed to meet water quality criteria in Pennsylvania and other states. We would recommend instead that states utilize effluent standards in their permit system with Federal review and monitoring of the permit system.

Another concern that we have relates to the constant "tinkering" with the pollution control program at the Federal level that has been going on in recent years. In the last six years the federal program has been in four agencies, reorganized seven times, and run by six different administrators. During the same period the federal law has been amended three times. As a consequence, many major changes in direction have occurred. This constantly moving target does not lend itself to good management and the establishment of a strong staff. Some change is desirable but constant change results in chaos. In order to carry out an effective water pollution control program, experts should be available to manage and carry out the federal program. Because of constant changes, sincere but inexperienced people are called upon to make decisions that do not enhance the national program and create confusion and delay. Water quality management is a very complex enterprise which reaches into every fiber of our social and economic system. If it is to suceed we need to give it some stability, nurture it and allow it to grow.

Finally, during the past year, we have become more and more concerned about the way in which regulations are promulgated and enforcement actions are initiated by the Environmental Protection Agency. When regulations and enforcement actions are proposed, there is little opportunity for discussion. The same person who issues the regulation evaluates the comments and there is very little change for change. We have found that an appeal or hearing board to which agencies, organizations and citizens can appeal decisions or actions can be a very effective tool in constructively implementing the regulatory aspects of our nation's water pollution control program. Such a hearing board should also reduce appeals to the courts and lighten their work load and provide a place for citizens to voice complaints regarding needed action.

## CONCLUSION

I believe that the people that are involved in the pollution control effort at the Federal level, state level and the local level are interested in one common goal, and that is improving and enhancing the water quality of the nation. Our objective is to get the most out of their work. I firmly believe that a national system rather than a federal system of water quality management and water pollution control will provide the quality of water that is needed for our national. States should be responsible for enforcing the law on a case-by-case basis. The federal government should provide the program guidance and have the ability to "step in" if the state does not do the job.

# THE TRIUMPHANT TECHNOCRATS AND NONFUNCTIONING FEDERALISM

David B. Walker*

Of the several challenges confronting the American federal system in the seventies, the least recognized and probably least understood is the growing gap between program specialists with their interest group and legislative allies and elected decision makers at all levels. Yet, in the long run, efforts to correct the fiscal crisis, to bring greater order to the jurisdictional jungle in our urban areas, to cut through the tangled web of intergovernmental administrative relations, and to improve service delivery systems will fail unless we see the vital connection between these challenges and the need to curb the growing power of specialized program functionaries at the three traditional levels, as well as at new, intermediate levels where neither the electorate nor elected officials operate directly.

## THE GENESIS OF THE GAP

How then did this gap between technocrats and political executives, between "program politics" and "electoral politics," emerge? In one sense, it is as old as our governmental system with its geographic division of powers, three separate branches, checks and balances, and internal legislative and administrative structure organized by function and is as traditional as our political system with all of its decentralized, comparatively undisciplined, ambiguously programmatic, and easy-access features. In another sense, it is rooted in the myth, which many have accepted as fact, that policy decisions and policy execution are two clearly separate governmental activities with entirely different sets of actors performing in the arenas. In a more contemporary sense, the gap stems from the public's--particularly the mushrooming urban public's--ever-increasing demand over the past quarter of a century for more and better, and in several instances, highly specialized, services and from the governmental response to these demands.

And what a response it has been. Total governmental expenditures multiplied more than six times between 1948 and 1970, surpassing the $333 billion level. Outlays in the civilian-domestic sector (excluding the insurance trust) rose from $36 billion in 1948 to over $200 billion by 1970. Overall governmental receipts quintupled between 1946 and 1970 (reaching $333 billion) while governmental indebtedness soared by more than 80%. In addition, the number of pulic employees more than doubled during the same period and the professional sector reached the point where it represented about one-third of the total.

But what has this rapid acceleration in governmental activity meant in terms of our federal system and the relationship between officials and program administrators? In general terms, State and local efforts have been greater than those of the Federal government, although Federal incentives and initiatives have helped generate much of the activity at the other levels. The State and local share of all revenues rose from 25% to over 38% between 1946 and 1969; their share of all domestic program expenditures passed the 70% level and their employees expanded by more than 160% during the same period. By way of contrast, the Federal proportion of total civil governmental outlays actually declined from 43.7% to less than 30% between 1948 and 1970; its indebtedness rose by 470%; and its personnel rolls grew by only approximately one-half million.

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*David B. Walker is Assistant Director of the Advisory Commission on Intergovernmental Relations. This article was excerpted from a speech delivered before the League of Minnesota Municipalities' Annual Convention, June 14, 1972.

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## THE SPECIAL ROLE OF GRANTS

At the same time, Federal aid increased nearly 20 times during the period 1948-1972 and the number of grants soared from approximately 34 at the end of 1947 to an estimated 530 today. The bulk of this increase came in the sixties when nearly 200 new grant programs were enacted in the three year period 1964-1966 alone.

More than any other single factor, it has been this near explosion in the number, dollar amounts, and types of Federal grants that created the intergovernmental system we know today. It was this Federal response to the public's demands for better, expanded, or new services that laid one of the basic foundations of the present imbalance between the power position of the program specialists and that of political leaders and their generalist allies.

Now certain positive aspects of this development should be noted:

--It was after all largely a response to real constituent demands and needs with the frequent support of elected officials and administrators from the State and local levels.
--It did hike the Federal contribution to State and local revenues from 10.4% in 1948 to over 20% in 1971.
--During the sixties, the grant system did experience a marked shift to urban problems and programs, with funds earmarked for these areas increasing by 258%.
--Its programs in the human resources area rose from 47% of 1960 total to an expected 55% for 1973, while those in the transportation and commerce fields dropped from 43% to 14% during the same period.
--To a greater degree than State aid, it did aid central cities more than suburbs; seventy of the central cities in the 72 largest metropolitan areas in 1970 did receive proportionately higher per capita Federal aid than did their suburbs in 1970.
--Above all, this heavy reliance on categorical grants to provide fiscal aid and to achieve various national domestic goals was essentially a traditional response; the grant device after all has been the chief means used by the national government to achieve such objectives for well over three score years.

Not to be overlooked in all this is the nearly as strong emphasis on categorical aid at the State level. While less narrow in scope than most Federal grants and growing in size every year, State aid to localities overall has been and still is largely conditional in nature. In 1970, for example, all but $2.9 billion, or only a little over one-tenth, of the $28 billion in total State aid fell in the general support--with few strings attached--category.

## THE FORCE OF THE FUNCTIONALISTS

These are but some of the more prominent fall-out problems generated by the growth of grants in the sixties. But one of the biggest is less visible, though nonetheless vibrant and real. Sometimes, it is described clinically as the rise of "functional government;" sometimes in historical terms, as the emergence of the "new feudalists" or as the "growth of the guilds;" and sometimes in more pungent terms, like the "vertical, functional autocracies." And recently, a noted political scientist, in effect, described this phenomenon as the end product, if not the bankruptcy, of "interest group liberalism."

Despite the differences in these descriptions, each of them tells us something of the nature of this basic challenge. It is primarily a functional phenomenon, rooted in the recent heavy expansion of specialized governmental activity at all levels. It does resemble certain features of the feudal system of the middle ages, wherein the ostensibly subordinate components of that system--the dukes, earls and barons--frequently possessed a far greater power than their monarch. It does take on some of the character of the old guild system, in that specialization, shared professional or technical goals, and common program objectives are the basic behavorial conditioners that give each of these functional groupings its essential unity and provides the basis for its opposition to outside interference. It does involve a vertical relationship, since the membership of each guild is drawn from all levels of government; and these groupings do appear autocratic to some, given their perennial resistance to genuine oversight by politically accountable officials and their near monopoly on the professional and technical skills required to perform much needed, but complex, governmental functions. Finally, there is a strong interest group overtone to the composition and strategies of these functional conglomerates; each of them, after all, is really a coalition of administrators, outside pressure group representatives, and legislative proponents within the pertinent standing committees. Whether this phenomenon is a product of American liberalism as it has evolved over the past four decades, is a question I will leave to the political theorists, historians, and politicians. Having said this, it does no harm to note that pressure group politics have been with us as long as we have had political parties and political conservatives as well as political liberals have been known to support individual grant programs, specific governmental departments and agencies, and certain interest groups.

## THE TENETS OF THE TECHNOCRATS

Seven years ago, the United States Senate Subcommittee on Intergovernmental Relations issued a report entitled "The Federal System as Seen by Federal Aid Officials." The findings of this study, based on the responses of over 100 middle management Federal grant officials, highlight the fundamental views of all the defenders of functional government regardless of the level at which they operate. Four basic attitudes emerged from their survey responses:

--Functionalism, or a preoccupation with protecting and promoting the purposes of their programs, was the dominant factor explaining their replies to the various questions posed.
--Professionalism, or a deep commitment to the merit system and to the technical and ethical standards of their specialized group, was nearly as significant.
--Standpattism, or a rigid defense of traditional practices, procedures, and principles, was also a major theme.
--And indifference, or the cavalier dismissal of various critical

intergovernmental issues as being irrelevant or unimportant, was the fourth attitude reflected in their responses.

Middle management executives, with a strong functional, professional, and status-quo orientation, are not likely to approach broad questions of a multifunctional, interlevel, interagency, or coordinating nature with any great enthusiasm or concern. But this attitude also relates to other factors. It stems in part from the ignorance that only the narrow specialist can display toward broader questions of management, policy, and governmental operations. In part it comes from an acute awareness that their expertise is needed and that their administrative positions are fairly secure. Second, they recognize that many of the larger intergovernmental questions can only be resolved by others more directly involved in the decision-making process at the Federal, State, and local levels. And it also is rooted in their own particular view of the system and of where the tension points are located.

These program specialists identified three major sources of conflict in contemporary intergovernmental relations: (1) Greater professionalism at higher levels versus a lesser degree of professionalism at the other levels; (2) Professional program administrators versus elected policy makers at all levels; and (3) Administrators of individual aid programs versus intergovernmental reformers.

This listing of tension points can not be ignored, since it underscores some fundamental antagonisms within our federal system that must be ameliorated, or at least curbed, if any of the other basic imbalances in the system are to be overcome.

## THE RESPONSE OF THE GENERALISTS

Now much has occurred since 1965 that suggests that elected decision makers and top management at all levels, as well as those deeply concerned with achieving a more workable and responsive system, have not been unaware of this challenge. Witness:

--The Intergovernmental Cooperation Act of 1968, which strengthens elected officials and improves the chances for better Federal-State-local administrative collaboration;
--Reorganization Plan No. 2 of 1970, which hopefully will strengthen the domestic policy formulation and management controls of the Presidency;
--The Legislative Reorganization Act of 1970, which provides new tools for legislative oversight and fiscal control;
--The 1969 reorganization of the Federal field offices;
--The Intergovernmental Personnel Act of 1970, which seeks to upgrade the core management sector at the State and local levels;
--The positive 1970 and 1971 actions in Georgia, Illinois, Kansas, Maryland, and North Carolina, which bring to 12 the number of States providing the governor with executive reorganization authority subject to a legislative veto;
--Legislative action during the past seven years achieving major or substantial executive branch reorganization in a dozen States;
--Annual legislative sessions, now in over two-thirds of the States;
--A decrease in the number of standing committees in 23 States and an increase in professional legislative staff in 39 during the past two years;
--More than 200 counties with appointed administrators and nearly 40 with elected county executives;
A significant increase (103) over the last decade in the number of cities (236) have planning agencies responsible to the mayor; and
--Adoption by nearly half the cities over 50,000 in size of some elements of a program, planning, budgeting system.

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## "THE BEAT GOES ON"

Despite these encouraging actions, other developments provide the basis for continuing pessimism. They all underscore the enduring strength of the functionalists and their skills in perfecting old--as well as developing new--ways of preserving their strategic position of influence at all of the three traditional levels of government as well as at the new emerging ones.

At the Federal level, a number of developments should be noted, especially those relating to grant consolidation and block grants. Many believed that the passage of the Partnership in Health Act of 1966 might inaugurate a trend toward consolidation of narrowly defined categorical programs. Beginning with a consolidation of 17 previously separate categories and with significant discretion given to States and their governors in developing locally relevant State plans, three new categories were tacked on in 1968 and in December 1970 the President signed the Communicable Diseases Act which added a half dozen or more additional strings to the original measure. Meanwhile, reports from the field indicate that many governors have given their health administrators primary control over the program and comprehensive health planning units have been established at the substate regional level--usually separate and rarely having much to do with other areawide bodies. In short, the categories and the functionalists seem to be winning out again.

Another apparent breakthrough for the block grant approach was the Safe Streets Act of 1968. Here consolidation was not so much an issue in the debate over the original measure, since only a minor Federal program in this area existed at the time. What was at stake was the issue of achieving a block grant at the outset, rather than a mix of categorical grants of both the formula-based and project variety. In its 1970 study of this measure, the Advisory Commission on Intergovernmental Relations (ACIR) endorsed the block grant approach contained in the original legislation. No other area perhaps lends itself so well to this form of assistance. The interfunctional, interlevel, and interbranch problems associated with police, prosecution, corrections, and courts at the State and local levels are so complex, yet so connected, that no other approach, in our opinion, would make any sense. Yet, with a block grant there goes the burden of free choice, of making critical decisions, of using the discretion that is assigned. And this rests with the State Planning Agencies (SPAs) under the Act. As a mechanism for bridging the many gaps in the non-systems that exist in most States, the SPAs must be representative of functionalists and generalists, of State and local top executives, of legislative and judicial as well as executive branch people. They must have strong gubernatorial backing and have an energetic, prestigious chairman. They must give balanced consideration to the needs of all components of the system and to areas that suffer from severe crime problems. This is an arduous assignment and the evidence suggests that some have found it too tough. In reaction to much of this, Congress in 1970 adopted a number of amendments to the Act. Twenty percent of the action funds now are earmarked for corrections and the States are obligated to "buy-into" the program insofar as the non-Federal matching for local projects is concerned.

Efforts to secure mergers in the library services and construction field met with meager success in the last Congress (a reduction of five to four programs was achieved, rather than five to one, as was proposed). Moreover, the various consolidations proposed for the 1970 housing legislation merely produced mergers in the open space and research programs. Revisions of the Hill-Burton program resulted in an additional construction grant, rather than the merger of five programs into one, as HEW sought. Efforts to achieve a single authorization for the seven in the Medical Library Assistance Extension Act also failed in 1970.

With the advent of the special revenue proposals in 1971 came a much bolder and far more encompassing approach to grant consolidation but one which still relied on the workings of the normal legislative process. Special revenue sharing emerged as part of the broader revenue sharing goal stressed in President Nixon's 1971 State of the Union Message. Ostensibly geared to complementing the proposed reorganization of the executive branch as well as general revenue sharing, the six special revenue sharing measures would consolidate some 129 categorical grants into six broad programs. They would provide automatic distribution of most of the funds, minimal administrative strings, no matching or maintenance of effort requirements, adherence to Federal civil rights and labor standards, a discretionary fund for each of the Federal administrators, and "hold harmless" provisions to insure that no jurisdiction receives less under the new program than it did under the previous ones during a stipulated base period. Despite these common features, the proposals differed from one another in certain respects with many of the distinctive features reflecting the special problems of each program area. By the end of 1971, only three of the special revenue sharing measures--education, manpower, and urban development--had been exposed to Senate hearings by the pertinent subcommittees. In the House, hearings had been held on only one--urban development.

Among the reasons for this slow pace were the comparatively late introduction of some of the special revenue sharing bills, the novelty of all of them, the absence of any real prior consultation with public interest groups and with the relevant Congressional committees, a heavy committee schedule in some instances, earlier Congressional action to the contrary as in the case of the 1970 Safe Streets amendments, and above all, concern over the fate of programs slated for consolidation or (particularly with the rural development proposal).

This brief chronicling of diverse consolidation efforts from 1966 through 1970 suggests that the need for merging narrow grant programs still is as great as ever. It indicates that the normal legislative course raises major hurdles of a political and program nature. It shows that even where a consolidation is temporarily successful, the tendency to recategorize is still strong, and that chief executives at the other levels must mount a vigorous initiative to curb the parochialism of their narrow program professionals if the discretion which comes to them from a block grant is to be retained. The record also suggests that broad, panoramic proposals that depart dramatically from the more usual consolidation approach are not likely to succeed.

With revenue sharing, the story, as of the moment, is almost as bleak.* But given the recent action of the Rules Committee, along with the concerted effort of elected policy makers from all levels, it seems likely that legislation in this area will be enacted before this Congress adjourns. Not to be overlooked here, however, has been the subtle but steady opposition of the individual program proponents, who view revenue sharing as a serious threat. Yet, revenue sharing will not succeed in strengthening the position of State and local elected decision makers and their core management allies, if these officials--by default or conscious design--permit the discretion it grants to slip into hands of middle management. In short, revenue sharing is no guarantee of stronger State and local leadership and management. In cases where this already is weak, it will simply amount to a rerouting of funds to line agency officials already aided under the categorical programs.

Regarding efforts to simplify and consolidate planning requirements under various categorical programs, much effort was expended by the Planning Assistance and

* General revenue sharing (The State and Local Fiscal Assistance Act) was signed into law on October 20, 1972.

Requirements Coordinating Committee. But no real results as yet are visible to the State, local, or neutral eye.

In the area of substate regional activities, two different strategies seem to be evolving: one for the generalists and the other for the program specialists. With the former, the A-95 process stemming from Section 204 of the Metropolitan Development Act of 1966 and the Intergovernmental Cooperation of 1968 stands out, since it basically benefits areawide bodies representative of general units of local government; and over 400 such units have been designated to perform the review and comment role under this clearinghouse procedure. With the program specialists, a different approach silently has been adopted, one geared to providing separate multijurisdictional mechanisms for various aided program activities. At latest count, there were:

--481 law enforcement and criminal justice planning regions;
--957 single and multicounty Community Action Agencies;
--419 substate CAMPS committees;
--129 regional comprehensive health planning agencies;
--115 Economic Development Districts;
--232 Air Quality Regions;
--50 Local Development Districts; and
--68 Resource Conservation Development Districts.

Now in some cases, the A-95 agency, has been utilized for some of these other federally encouraged areawide efforts. But findings of a 1970 survey indicate that only 21% of the 186 A-95 agencies polled were used for law enforcement planning; only nine percent for comprehensive health planning; only eight percent for economic development programs; only two percent for resource conservation; and only one percent for air quality control. It seems safe to say that the A-95's are having a very difficult time in absorbing or monitoring the efforts of these new breed of special districts in most metropolitan and some rural areas and this, in no small measure, relates to the strength and support that the program specialists continue to enjoy at the Federal and State levels. From the vantagepoint of local governmental policy makers, however, the specter of proliferating Federal-State mechanisms at the substate regional level should be some cause for alarm. Certainly, the resolution on this subject voted by the mayors at Hawaii in December of last year reflected some growing municipal concern.

In the State capitols, other developments underscore the resiliance of the functionalists at this level, including:

--Very few of the 12 recent State reorganizations did much by way of reducing the number of separately elected constitutional officials;
--Most of these executive branch reorganizations did not eliminate or seriously disturb the power of the more well established separate boards and commissions;
--The vast majority of the State planning efforts have not had an impact on the budgeting process or on the activities of line agencies and departments;
--Only a handful of State legislatures have a post-audit service comparable to that provided by the General Accounting Office to the Congress;
--Special districts, always a secure haven for program specialists, increased by more than 36 percent nationwide between 1962 and 1972, reaching the 24,942 mark; Minnesota enjoyed an 86 percent hike during this period;
--All but 7,580 of these nearly 25,000 special districts had boundaries that overlapped those of general units of local government and their total

expenditure amounted to nearly $5 billion in 1967;
--This growth in special districts stems directly from either general or specially authorized State legislation, and no State has taken action to institute effective curbs on these authorities;
--Some 42 States have moved on the substate regional districting front, but in a majority of instances this has yet to affect the activities of State line agencies or Federal-State areawide program efforts.

## AN ACTION AGENDA

These are but a few of the signs at the Federal and State levels that the "functionalists" are still the "wheel horses of the federal system." Where then does this leave us? It leaves us with elected decision makers who don't really decide, with top management that isn't on the top, with legislative oversight that rarely produces broad insight, and with an electoral process that has minimum impact on administration. It also leaves us with the program for intergovernmental reform that has been before us for some time. It includes:

--Revenue sharing, joint funding simplification, and the grant consolidation authority provided in the proposed Intergovernmental Cooperation Act of 1972;
--A continuation of Federal Assistance Review program at the Washington level;
--The development of a real Presidential presence in the Federal Regional Councils;
--An effective melding of State budgeting and planning efforts;
--More effective legislative oversight at all levels and a better post-audit at the State level;
--A clearer understanding of the real purposes of the substate regional districts, especially as they relate to State agency, Federal-State program, and local governmental activities;
--State legislation along the lines of the ACIR's draft bill to check the growing power of special districts;
--A combined State and local drive to force the Federal administrators to ponder the consequences of continuing proliferation of separate unifunctional areawide bodies;
--An ending of the ambivalence in the minds of many local officials and citizens regarding the role of metropolitan and multicounty bodies (this ambivalence, after all, has helped to create the vacuum at the areawide level which the program specialists now are filling); and
--Finally, a deeper understanding within the electorate as a whole that failure to arm elected officials with adequate formal authority only strengthens the power of the "new feudalists"; and we are fast reaching the point where this understanding must be extended to the substate regional level, since--with the exception of a handful of metropolitan areas--there are at this level neither elected officials with any areawide authority nor an electorate empowered to interact with such officials by the ballot box or any other means.

These are all means of righting the imbalance between the political decision makers and the program administrators, between electoral politics and program politics, between balanced and accountable decision making and skewed, fragmented decision making. These reforms are necessary if policy makers at all levels--the President and the Congress, the governor and the legislature, the mayor and the council--are to be strengthened in a fashion that will permit them to withstand the mounting, parochial pressures that swirl around them. Top policy makers at all levels must be empowered to plan, pass, implement, and fund the vital programs that this and future generations of Americans require. If we fail to correct this imbalance in the system, then popular alienation and cynicism regarding our governments can only grow.

# A PROTOTYPE OF ENVIRONMENTAL CIVILIZATION

William D. Ruckelshaus*

The first time I flew to California I was overwhelmed by the complexity and diversity of this State.

My hosts reminded me that if independent, California would be a major power, boasting an economy larger than any other country except our own, Japan or the Soviet Union. They pointed out that it is a sort of sub-continent, spanning most of the earth's biomes and climates. They told me with an unmistakable pride that California embraces every kind of topography, that it enjoys vast mineral wealth and agricultural resources, that it has some of the finest parks and most extraordinary landscapes in the world. Moreover, they continued, the State entertains every conceivable ideology and idiosyncracy, and some that are inconceivable too.

Like any newcomer I could not take it all in the first time around. On subsequent trips I gained an instinctive feeling that California is not only a microcosm of the United States, but also a prototype of what it may become. Many of our problems have been anticipated here: problems of prosperity, growth, development, urban sprawl and pollution. Not surprisingly, California is vocal in demanding sensible solutions. There is a stark realization that we have not treated our heritage of bright skies, open land and sparkling waters as we should have, that perhaps we grew without thinking about all the social and environmental consequences of a machine-oriented civilization.

No nation in history has ever developed as fast as the United States. Starting virtually from scratch, we created in one century the world's first industrial society on a continental scale. Since we derived great benefits from the exploitation of natural resources, it is understandable that we equated all forms of development with progress. Growth was justified by our successes, and sanctified by reference to Holy Scripture. We obeyed the injunction to be fruitful and multiply and take dominion over the earth, but we ignored the careful husbandry the sacred text also calls for.

Today, however, there is a new mood in this country. People are disposed to look more carefully at their past assumptions, including those that have brought them wealth, comfort and convenience.

It is striking that no generation before ours has been quite as obsessed with growth itself. Prior to World War II, heavy emphasis was placed on employment and income, but little attention was paid to the Gross National Product. Marshall Goldman, the specialist in comparative economics, has reminded us that for some time after the war we did not even have annual GNP readings. The concept of GNP was largely historical until the Soviets goaded us with their relentless emphasis on growth rates. So we may have been sandbagged into competing on their terms instead of ours.

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Both we and the Soviets tend to forget that at best GNP is only a rough indicator of national progress. It embraces all the elements of our economy including the production of luxury goods, first-aid for highway accident victims, the operation of prisons, medical treatment for people made ill by air pollution--and many other expenditures necessitated by circumstance instead of volition. Such outlays are evidence that growth is a more complicated matter than one might think at first.

Take resources as another example. It has been estimated that if the U.S. and other nations maintain consumption at present rates, all known reserves of zinc, lead, tin, copper, petroleum and other materials will be exhausted within 30 years. It is obvious that we are running short of easily recovered surface deposits--those that gave such a boost to the industrial revolution 200 years ago. Modern technology may replace many of the disappearing substances or recover them from deep mines or deposits on the ocean floor. But the heavy cost of such operations means that mineral resources are bound to become more expensive.

To bring the problem of diminishing returns close to home let me remind you that before this day is over each one of us will generate six pounds of solid waste, drain three gallons of irreplaceable oil from the earth, dump 40 gallons of sewage into the rivers and use paper equal to one-eighth of a mature tree.

Such rapid through-puts generate a tremendous impact on the environment and on the quality of our lives. Today, not even the richest man can avoid the smog, the putrid waters, the noise, the stench, the congestion and the general ugliness of industrial civilization. He may escape them on a fishing trip, but as an angler I've found that when everyone else gets the same idea at the same time, you're in for some real aggravation.

Anyone who has visited the national parks or dwindling open beaches knows at first hand the impact of population and prosperity on our finite resources of land and natural beauty. It is hard to believe, but true, that the National Park System recorded 79 million visitors in 1960, 121 million in 1965 and 186 million in 1971. The 200-million figure is only a couple of years away.

Unless something is done, the serenity people seek in nature will be destroyed by their own numbers. That's why several States are trying to regulate the trend toward ever-increasing resident populations and ever-increasing hordes of tourists competing for space.

For example, the Colorado Environmental Commission is calling for a ceiling of 1.5 million inhabitants for cities in that State. The public has been advised that water-expansion programs will generate a rising tide of population growth, pollution, traffic jams and loss of the very amenities that brought people to Colorado in the first place.

This same concern is emerging elsewhere. Vermont has set up a statewide zoning system to protect ecologically fragile areas. Wisconsin has announced it will establish a policy to prevent unbalanced growth. Oregon is considering the constitutional implications of controls on tourism as well as on permanent immigration. Hawaii is contemplating optimal population limits. Florida just passed a tough land-use bill. Delaware has outlawed heavy industry along her beaches.

Here in California, Livermore and Pleasanton voted to prohibit building permits in areas where schools are overcrowded, where water rationing is imminent or where sewage facilities are inadequate. Sacramento County has established its now-famous urban limit line. Several other communities have acted against growth in its classical form. I was surprised to see that the drastic Proposition 9 got 35 percent of the primary vote a few months back. And now, a new referendum is to be held November 7* on the question of freezing development of the California coastline.

Meanwhile, the California Supreme Court has held that the State's Environmental Quality Act applies to licensing of private activities as well as to State projects. This interpretation, perhaps inspired indirectly by the National Environmental Policy Act, made instant hash of California building permit procedures. In a recent *Washington Post* column, Joseph Kraft said the permit problem "symbolizes a dramatic change in the message which this area. . .has been transmitting to the rest of the country. No longer does it offer the prospect of growth unrelenting; no longer does it proclaim the case for go, go, go."

Another California court ruling--to my knowledge the first of its kind in the Nation--holds that municipalities can force developers to set aside land for public purposes notwithstanding the provisions of the State constitution requiring compensation for land taken or damaged. This expansion of the historic doctrine of eminent domain gives local governments vast new powers in recreational land planning, watershed management and wilderness protection.

I cite all of these initiatives not to endorse them, but to call attention to the rapid shifts in public attitudes that make them possible. Californians, like other Americans, are beginning to ask certain fundamental questions about life values--and since this State is more developed than most, I would not be surprised if it becomes a major point of collision between pro-growth and anti-growth forces in coming years.

Let me give you a few examples of exponential growth in order to clarify and promote dispassionate analysis of our environmental dilemma. It is easy to overlook how rapidly a phenomenon can get out of hand when it grows at a compound rate. But one instructive analogy was developed by the 17th century French philosopher and mathematician Pascal, who amused the neighbor children with a riddle based on the growth rate of lilies and how rapidly they approach a fixed limit determined by nature.

Suppose you own a large pond with one lily in it. The plant doubles in size each day and will choke the entire pond on the 30th day. On the first day, it is only one-five-hundred-thirty-seven millionth the area of the pond. You have plenty of time, so you decide to wait and trim the lily back when it covers half the surface.

For the first ten of the 30 days, the plant is less than one-millionth the size of the pond. Between day 10 and day 20, it grows from one-millionth to one-thousandth of the available area. That is a large relative increase but you're not worried because 99.9 percent of the pond is still open and biologically healthy.

As dawn breaks on the 25th day, the lily is still only one-thirty-second the size of the pond. The final explosion is fabulous to watch--an inexorable progression from one-sixteenth to one-eight to one-fourth and finally to one-half on the 29th day. You have one day in which to restore the living balance and save your pond.

*The referendum was approved by the California electorate.

The same law of exponentiality applies to animal populations. Under optimal stimulae they quickly expand to the physical limits of land or marine habitats. The closer they approach those limits, the more drastic is the ensuing die-back.

We see numerous examples of animal population collapse brought on by shortages of food, impedance of territoriality and interference with breeding patterns. Many experts believe mankind is also heading toward a demographic "implosion."

But vanishing resources and overpopulation are not the only problems we face. Some are extremely subtle; indeed, geometric processes are even visible in the realm of industrial investment. During this year, investment in industrial facilities is expected to grow by 10.2 percent. At this high rate, capacity would double every seven years. Thus if pollution control technology is 85 percent effective in existing plants it will be just 70 percent as effective in cutting gross pollution tonnages seven years from now when production of everything, including contaminants, has doubled, and only 40 percent as effective seven years thence, when it has doubled again. After three successive seven-year doublings, the actual amount of pollution is 120 percent more than it was 21 years earlier before abatement began, even assuming pollution control at a remarkable 85 percent effectiveness level all along.

Thus exponential growth in industrial capacity ultimately--and not very far in the future at that--could require almost perfect abatement technology to assure just an adequate level of amenity and health, let alone the high standards we might prefer. This outcome is postponed somewhat in an economy gradually switching over to services from heavy goods, but the example would nevertheless hold true for the world as a whole.

One could go on and on with such analogies--in the dissemination of chemicals, in solid waste disposal, in effects on world energy balance and climate, ad infinitum. Everything is linked to everything else in the closed system of the planet Earth. Certainly the facts as we know them require the asking of the most basic questions. Will Draconian measures of pollution control be necessary? Are large populations compatible with high standards of living over the long-haul? Can we continue to unbalance natural processes--wiping out hundreds of plant and animal species--without paying a fateful penalty? Such profound questions cannot yet be answered with confidence. The analogies may be correct, or they may be empirically worthless.

One international group of scientists and businessmen earlier this year attempted to project into the 21st Century the consequences of present trends in population, resources, investment, food technology and pollution. The Club of Rome developed a computer-based forecast purporting to show that we are in for real trouble within the next 50 to 100 years--and perhaps disaster--unless we cut back on growth now and eventually reduce it to zero.

Such a proposition strikes most of us at first as absurd. Scholars both here and in Europe have faulted the Club's statistical methods on one ground or another. Yet the study did cast a spotlight on certain implications of current growth patterns. It challenged us to rethink some venerable assumptions. The fact is that we are confronted by serious imbalances, and they must be dealt with in a more sophisticated manner than heretofore.

My hope is that the Club of Rome projections will prompt a great national and international debate on broad philosophical issues stemming from technology and industrialism on a world scale. Thanks to the agreements recently concluded by the President, we can count on the Soviets to contribute their insights to this historical reanalysis.

Maybe the concern and even alarm in some quarters will turn out to be groundless. Certainly, the prophets of doom have on many past occasions gathered us together to await the Day of Judgment, and nothing has happened. That may be the case this time. But prudence, and what Jefferson called an appropriate deference to the opinions of mankind, require us to get our heads just a little further out of the sand and go after some solid answers. We in EPA and others all over the world are eagerly pursuing the research leads that can give us the information we need.

I am certain of one thing only: environmental pressures are just beginning. State and local governments and business leaders should respond to this pressure, not just reactively, but aggressively seeking opportunities to act as social catalysts. That is the only way we can preserve faith in a free economic system and a free society.

The shift to an environmental civilization will not be easy, fast or cheap. But there is growing national consensus that it must happen. People are tired of change for the sake of change. They want progress for a purpose. They are embracing a new consciousness, a new vision of reality, a new sense of their place in nature. They are ready to practice a new stewardship of the earth.

Mankind has hung on, somehow, through dark millennia of ignorance, disease, torture, starvation and endless warfare. We are beginning to see the truth about ourselves and to act wisely. So I do have faith that we can overcome. In my opinion man will not only survive, he will prevail.